# General Information

## Martin Marietta Corp.

## Economic Impact (Denver Area)

Capital Assets (1987)--$535 million

Colorado Payroll (1986)--$573.4 million

Colorado Purchases (1986)--$153 million

Withholding for Colo. Taxes (1986)--$20.6 million

Property Taxes (1986)--$7.6 million

## Colorado Employment

(As of Jan. 1, 1987)

| | |
|---|---|
| Astronautics Group | 11,397 |
| Information & Communications Systems | 1,638 |
| Data Systems | 1,700 |
| TOTAL CORPORATION | 14,735 |

## Management

| | |
|---|---|
| Peter B. Teets | President<br>Astronautics Group |
| Gareth D. Flora | President<br>Space Launch Systems |
| Richard E. Brackeen | President<br>Commercial Titan, Inc. |
| James A. Sterhardt | President<br>Strategic Systems |
| James W. McAnally | President<br>Space Systems |
| Raymond J. Nalty | Vice President<br>Business Management |
| Joseph C. Spencer | Vice President<br>Business Development |
| Richard E. Weber | Vice President<br>Personnel |
| Stanley F. Albrecht | Vice President<br>Plant Operations |

| | |
|---|---|
| Warren G. Beery | Vice President<br>Technical Operations |
| Arthur E. Koski | Director<br>Public Relations |
| Arnold F. Roane | Director<br>Administration |
| Michael A. Steuer | General Counsel |
| Nicholas Van Dewerker | Director<br>Product Assurance |

## Corporation

Martin Marietta Corporation, headquartered in Bethesda, Maryland, is an aerospace and information technology company. It designs, manufactures and integrates systems and products in the fields of space, defense, electronics, communications, information management, energy and materials. The Corporation employs more than 68,000 people in the United States and 14 other countries.

The Corporation consists of four major groups. They include Martin Marietta Astronautics Group, headquartered in Denver, Colorado; Martin Marietta Electronics & Missiles Group, headquartered in Orlando, Florida; Martin Marietta Information Systems Group, headquartered in Bethesda; and Martin Marietta Materials Group, also with headquarters in Bethesda. In addition to the four groups, Martin Marietta also has a Manned Space Systems company based in New Orleans, Louisiana.

Other entities comprising the Corporation are Martin Marietta Energy Systems, Inc., a wholly owned subsidiary; Martin Marietta Laboratories; and two real estate subsidiaries.

In 1986, Martin Marietta Corporation had net sales of $4.75 billion, and net earnings of $202 million.

## Martin Marietta Astronautics Group

Martin Marietta Astronautics Group, headquartered in Denver, designs, develops, tests, and manufactures a variety of high technology systems for space and defense. Its chief products include civil and military space systems, space launch systems for both government and commercial applications, and strategic systems for the Department of Defense.

The group comprises four companies: Martin Marietta Space Systems, Martin Marietta Space Launch Systems, Martin Marietta Commercial Titan, Inc., and Martin Marietta Strategic Systems.

The Space Systems company produces planetary spacecraft, instruments and experiments, and other space systems for the National Aeronautics and Space Administration (NASA), as well as military space systems. It is responsible for the group's Strategic Defense Initiative work.

Space Launch Systems designs and builds three Titan launch systems--the Titan II, a low-cost launch vehicle being converted from decommissioned Titan II intercontinental ballistic missiles (ICBMs); the Titan III, the Air Force's current operational Titan launch vehicle; and the Titan IV, which will be used to launch Space Shuttle-equivalent or heavier payloads. The company also builds upper stages to place satellites into higher orbits, and is studying an advanced launch system.

Commercial Titan Inc. commercially markets the Titan III as a national and international launch vehicle for commercial satellites.

(more)

Strategic Systems is primarily responsible for Martin Marietta's work on the Peacekeeper ICBM and the new, Small ICBM--missiles in production and under development, respectively, for the Air Force. The company is the assembly, test, and system support contractor for both programs, and builds the post-boost vehicle for the Small ICBM.

In addition to its Colorado location, Martin Marietta Astronautics Group has operations at Vandenberg Air Force Base, California, and Cape Canaveral, Florida, and several smaller field offices.

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# Space Launch Systems

## Titan II

The Titan II space launch vehicle is a modified Titan II ICBM that will be used to launch satellites into orbit. All Titan II ICBMs have been deactivated, and Space Launch Systems has an Air Force contract to convert 13 Titan IIs to expendable space launch vehicles. This entails modifying the basic missiles, ground equipment, and space launch complex from which they will be launched. The Air Force plans an initial launch capability of a Titan II in April 1988 from Vandenberg Air Force Base, California, with subsequent launches continuing into 1995.

## Titan 34D

The Titan 34D is a member of the Titan III series of expendable space launch vehicles, and is the Air Force's current operational Titan launcher. Titan III has been the Air Force's principal launch vehicle for critical national security payloads since 1966, and had successfully completed 131 of 136 operational launches as of October 26, 1987, for a 96.3 percent success rate. Designed and built by Martin Marietta for the Air Force, the Titan 34D can deploy single or multiple payloads to low, transfer, or geosynchronous Earth orbits, as well as on deep space or interplanetary flights.

Titan IV

In February 1985, Martin Marietta was selected by the U.S. Air Force to build and launch ten new expendable launch vehicles. Called the Titan IV, the vehicle is an improved version of the highly successful Titan III space launch vehicle. Since the initial contract award, the program has been expanded to 23 vehicles consisting of three different configurations. The Titan IV, which is capable of placing 10,000-pound payloads into geosynchronous orbit when used with the Centaur upper stage or 39,000 pounds into low-Earth orbit, will become the nation's largest operational expendable launch vehicle. It will be launched from both Cape Canaveral Air Force Station, Florida, and Vandenberg Air Force Base, California, with the first launch planned for 1988.

## Transtage

Transtage is a storable liquid bi-propellant upper stage used in conjunction with Titan launch systems. It is used as the fourth stage of the Titan to boost single or multiple payloads weighing up to 4,000 pounds into geosynchronous orbit. With its ability for multiple starts, Transtage has deployed as many as eight satellites during a single mission. Martin Marietta has built and delivered 47 Transtages for the U.S. Air Force, and 39 of those have been flown.

## Transfer Orbit Stage

Martin Marietta and Orbital Sciences Corporation (OSC) are producing an upper stage system to boost satellites from low-Earth orbits to higher orbits and planetary escape trajectories. OSC has contracted with Martin Marietta for two transfer orbit stages, which will place 5,000- to 13,000-pound payloads into geosynchronous transfer orbit or deliver spacecraft into planetary trajectories. The two vehicles will be used by NASA for the Mars Observer and the Advanced Communications Technology Satellite.

Advanced Launch System

Martin Marietta is conducting a one-year study of a low-cost, advanced launch system under contract to the Air Force. The study concentrates on a total launch system to lower the cost per pound of placing a payload into orbit by a factor of ten. The system will be available by 1998, with an interim system available by 1993-1994. The interim system, using some existing launch system technology, would be available in the event a decision were made by 1988 or 1989 to deploy an initial strategic defense system or structures for the space station.

A new launch facility would be developed for the interim and objective boosters, with final assembly and checkout of the advanced launch system at the launch site using a minimum number of ground crew personnel. The system will be capable of deploying five million pounds per year by 1998.

## Commercial Titan, Inc.

Martin Marietta is offering a version of its Titan space launch vehicle for commercial satellite launches. The commercial Titan, which has a 13.1-foot-diameter payload fairing, can place 4,200 pounds into geosynchronous orbit and payloads in excess of 31,000 pounds into low-Earth orbit. It also has the capability of placing 11,000 pounds into geosynchronous transfer orbit. The Titan III commercial launch vehicle will be compatible with a variety of specialized upper stages and can be configured for a wide range of orbits, multiple payloads, and complex mission operations.

In May 1987, Martin Marietta formed a new organization called Martin Marietta Commercial Titan, Inc. to market the Titan III commercially as a national and international launch vehicle for commercial satellites. The commercial Titan will be launched beginning in 1989 from Cape Canaveral Air Force Station, Florida.

# Strategic Systems

## Peacekeeper

The Peacekeeper is a four-stage intercontinental ballistic missile that carries 10 independently targetable warheads. It currently is under development by the U.S. Air Force. As assembly, test, and system support contractor to the Air Force, Strategic Systems provides instrumentation and flight system safety hardware for both airborne and ground support equipment, transportation and handling equipment, systems engineering and analysis, missile emplacer equipment, assembly and checkout planning, logistics and the conduct of the test program at Vandenberg Air Force Base, California. As of April 1987, Peacekeeper had successfully completed 17 test flights for a 100 percent success record.

## Small ICBM

The small intercontinental ballistic missile (ICBM) is a small, single-warhead missile with intercontinental range under development by the Air Force. As currently envisioned, it will be 52 feet long, 46 inches in diameter, and will weigh 37,000 pounds. It will carry an MK-21 warhead on three solid-fuel stages and a post-boost vehicle, and will be based in mobile launchers. Strategic Systems is the Air Force's contractor for Small ICBM assembly, test, and system support--the same role it has on Peacekeeper. In addition,the company is building the post-boost vehicle. The company will conduct the Small ICBM flight test program for the Air Force at Vandenberg Air Force Base, California, beginning in early 1989.

# Space Systems

## Magellan

Magellan is an unmanned planetary spacecraft designed to provide detailed information on the origin, evolution, and present state of Venus. Scheduled to be launched by NASA on the Space Shuttle in 1989, the Magellan spacecraft will orbit the planet and send back photograph-like images of its surface using synthetic aperture radar to pierce the clouds of carbon dioxide and sulfuric acid that enshroud the planet. The probe also will measure Venus' gravity field for study of the planet's density and distribution of elements. Space Systems has a NASA contract to design, develop, manufacture, test, and deliver the Magellan spacecraft, and provide mission support.

## Tethered Satellite System

The tethered satellite is a reusable satellite designed to be deployed from and retrieved to the Space Shuttle orbiter using a tether up to 62 miles long. Under development by NASA and the Italian Council for National Research, the satellite system will allow study of areas of the upper atmosphere previously accessible only to sounding rockets or balloons on brief flights. The system also will be used to study electrodynamics and power generation. Space Systems is under contract to NASA's Marshall Space Flight Center for the design, development, manufacture, test and delivery of the tether and deployer portion of the system. The company also is responsible for integration of the deployer with satellite. The tethered satellite is scheduled to fly on the Shuttle.

## Faint Object Spectrograph

The faint object spectrograph (FOS) has been developed by Martin Marietta for NASA's Hubble Space Telescope, scheduled for launch by the Space Shuttle in late 1988. Martin Marietta teamed with the University of California at San Diego to design, build, and test the high sensitivity astronomical spectrograph. The FOS and other Space Telescope instruments will enable man to explore the outer reaches of space, uninhibited by the Earth's atmosphere, and promise to greatly expand man's knowledge of space.

## Galileo Jupiter Spacecraft and Entry Probe

NASA has scheduled a major deep-space probe called Galileo to investigate the planet Jupiter. Current plans call for the Galileo spacecraft to be carried into orbit by the Space Shuttle and then launched by a rocket toward Jupiter, although an option is being kept open to fly Galileo on a Titan IV. At Jupiter, the spacecraft will release a probe into the planet's atmosphere. Martin Marietta has built three instruments to be carried by the Galileo Jupiter entry probe and provided the attitude and articulation control flight electronics on the spacecraft.

## Manned Maneuvering Unit

Martin Marietta developed the manned maneuvering unit (MMU) under contract to NASA's Johnson Space Center. The MMU gives astronauts the capability to operate untethered in space, thus providing the essential tool required to assemble, service and repair spacecraft. In 1984 astronauts flew nine sorties on three Space Shuttle missions using two MMUs for a total of 10 hours, 22 minutes. Both flight units were flown in February 1984 on STS 11/41B for more than five hours of operations. In April 1984, the MMUs were employed in a successful mission (STS 13/41C) to repair the Solar Maximum Observatory satellite. Finally, in November 1984, the MMUs were used in a mission (STS 51A) to retrieve two errant communications satellites -- the Palapa B-2 and Westar 6 -- which were brought back to Earth for repair.

## Shuttle Orbiter Subsystems

Space Systems supplies a number of subsystems for the Space Shuttle orbiter. This hardware includes the solid rocket booster recovery system, caution and warning electronics, reaction control system fuel tanks, and the pyrotechnic initiator control systems for ordnance mechanisms aboard the Shuttle. The Shuttle, man's first reusable launch vehicle, makes possible the routine use of space for scientific, defense, and commercial needs.

Strategic Defense Initiative

The Strategic Defense Initiative (SDI) is a research program to investigate ways that the United States and its allies can defend themselves against a ballistic missile attack. It involves a number of different weapon concepts, both space-based and ground-based; an overall architectural effort and a simulation and test capability; command, control, and communications ($C^3$), and battle management; surveillance programs; and new, innovative technological concepts. The kinds of weapons include kinetic energy and directed energy weapons. The SDI effort also involves an overlay of the logistical and launch support servicing concepts to support any architecture.

Martin Marietta is involved in SDI in a number of ways. The company is helping the SDI Organization to define and evaluate architectures for a system, and also is studying concepts for an acquisition, tracking, and pointing platform to be used in a directed energy weapon ballistic missile system. In addition, Space Systems has a concept definition contract for an SDI tracking and pointing experiment to be flown on the Space Shuttle or an expendable launch vehicle. Finally, the company has a contract to define concepts and develop technologies for a space-based interceptor.

## Rapid Retargeting Laboratory

The Rapid Retargeting Laboratory houses a ground-based simulator that will be used to test the performance of extremely sensitive space systems which require the ability to precisely and quickly point from one target to another. The simulator was built by Martin Marietta under contract to the Strategic Defense Initiative Organization. It provides a national research test bed for elements of space-based defense systems. Located in a facility set on seismically stable bedrock, the simulator allows evaluation of space experiment results and provides direction for additional experiments.

## Autonomous Land Vehicle

The autonomous land vehicle (ALV) is a driverless, land-roving, robot vehicle used as a national test bed for industry and university developments in artificial intelligence and advanced computer architectures. The ALV is a self-contained vehicle that operates independently of human intervention by means of artificial intelligence and advanced sensory perception technologies. An available wheeled vehicle has been redesigned and fitted with developmental computational and sensory perception equipment. Martin Marietta is under contract to the Defense Advanced Research Projects Agency to develop and integrate systems for the ALV.

## Space Station

The space station, under development by NASA, will be a multi-purpose system of permanent, manned and unmanned elements in orbit communicating with ground support facilities. It will establish a permanent United States human presence in space by the mid 1990s.

Martin Marietta has been conducting preliminary design work on the space station since March 1985, when the company was selected by NASA's Marshall Space Flight Center for one of two Phase B contracts. The work includes definition and preliminary design of the station's laboratory and habitation modules, the logistics modules, and the resource node structures that will link the modules. It also includes the station's environmental control and life support system; distribution of electrical power and data; internal lighting, thermal control, audio and video; and applications software.

NASA issued requests for proposals to industry for the next phase of space station development in April 1987, and Martin Marietta has submitted a proposal to build the station's U.S. modules and other systems.

## Information & Communications Systems

Martin Marietta Information & Communications Systems (I&CS) designs, builds, and integrates advanced information processing and communications systems combining the latest technologies in electronics, communications, signal processing, and data processing. One of the operating companies of Martin Marietta's Information Systems Group, I&CS was established in 1984. It employs approximately 1,750 persons in the Denver area, where it is headquartered.

Current I&CS activities in Denver include command, control, communications and intelligence ($C^3I$) systems for the military services, electronic warfare systems, advanced communications, large management information systems, and a prototype national test bed (NTB) for the Strategic Defense Initiative (SDI). The prototype is used to simulate, evaluate, and test SDI concepts.

Denver I&CS is the lead element in the Corporation for the development of expertise in the strategic technologies of information networking and multi-level security. The company also is engaged in the application of artificial intelligence to intelligence systems.

## Data Systems

Created in 1970, Martin Marietta Data Systems is the other operating company in Martin Marietta's Information Systems Group. Data Systems provides the Corporation and various government and commercial businesses with complete information management services and support. Data Systems is among the top ten information service organizations in the world, with 1986 sales of $468 million. It has more than 6,000 employees worldwide.

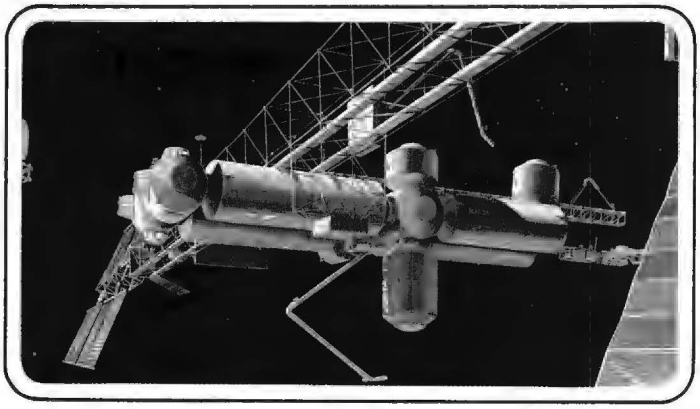
Data Systems employs 1,700 persons in the Denver area, and is divided into two separate organizations. One, called the Denver account, provides integrated information processing services and support to Martin Marietta Astronautics Group and I&CS. The other organization is called field services and provides on-site facilities management services, hardware and software conversions, custom-built systems and consulting to both government and commercial customers worldwide.

# SPACE STATION

Martin Marietta, under contract to NASA, is defining and conducting preliminary design of the United States modules for NASA's space station. The space station, planned to be operational by the mid-1990s, initially will have two United States-supplied modules—one for use as a laboratory, and one for living quarters, with two smaller modules for logistics support. It also will have modules provided by Japan and the European Space Agency.

Martin Marietta's role in the program is to define and conduct preliminary design of the space station's laboratory module, which will be used for materials research, manufacturing, and life sciences research; the habitability module, where the astronauts will live; and two logistics modules, which will be used for resupplying station consumables. The work also includes defining structures for the module interconnecting resource nodes and airlocks as well as environmental control and life support systems, and module data management, power, communications, and thermal control.

# FACTS SPACE SYSTEMS

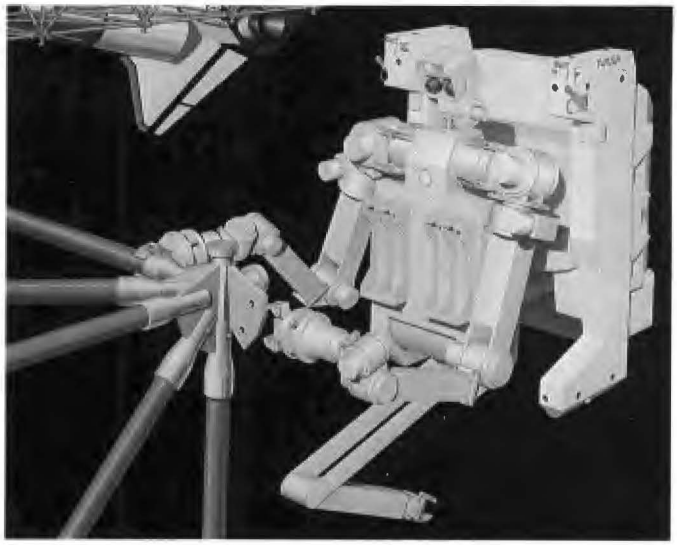


**NASA has planned the space station so that it will be suitable and adaptable for a wide variety of tasks. It will be used as a laboratory for scientific experiments and a base to explore the universe. The space station also can be used to develop and manufacture new materials and processes, to assemble antennas and other large structures, and to repair and refuel satellites and other spacecraft.**

MARTIN MARIETTA

The company is performing its space station work under a contract awarded by NASA's Marshall Space Flight Center, Huntsville, AL. Marshall is managing one of four NASA work packages covering all phases of space station development. The other work packages cover the structural framework where the various station elements will be attached; automated, free-flying platforms; and electrical power generation, conditioning, and storage.

The space station will be a multipurpose system of permanent, manned and unmanned elements on orbit communicating with ground support facilities. NASA is designing the space station to be capable of growing in size and capability, and expects to operate it for several decades.



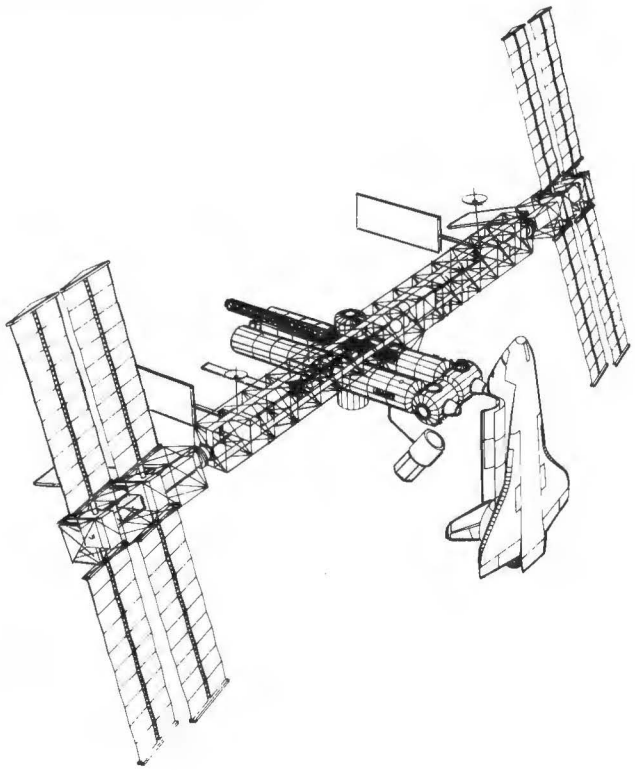
Smart Front End on Manned Maneuvering Unit

Components of the space station, built on Earth to fit into the cargo bay of the space shuttle orbiter, will be taken to low-Earth orbit by the shuttle. Over a period of months, they will be assembled by astronauts, possibly using Martin Marietta's manned maneuvering units, and robotic devices. As a later option, the space station will be held together by trusswork in an enhanced dual keel configuration consisting of two vertical keels connected by three transverse booms.

When fully assembled, the initial space station will weigh about 300,000 pounds and accommodate a crew of eight, with a replacement crew brought on board periodically when consumables are depleted.

The space station will have a photovoltaic power system. A partially closed-loop environmental control and life support system will recycle oxygen and water, with potable water to be distilled, and nitrogen and food resupplied.

Orbiting 250 miles above the Earth, the space station will be used to conduct experiments in space physics, astronomy, life sciences, and material sciences. It also will serve as a base to explore the universe, a factory to develop and manufacture new materials and processes, a facility for assembling antennas and other large structures, and for satellite repair and servicing.



*August 1987*

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**Denver, Colorado 80201**

# TITAN II

Martin Marietta is under contract to the U.S. Air Force, Space Division, to refurbish deactivated Titan II intercontinental ballistic missiles (ICBM) for use as space launch vehicles. The company was awarded a contract in January 1986—that runs through September 1995—to refurbish eight vehicles, with an option for five more.

Tasks involved in converting the Titan II ICBMs into space launch vehicles include: modifying the forward structure of the second stage to accommodate a 10-ft-diameter payload fairing with variable lengths; manufacturing the new fairing plus payload adapters; refurbishing the Titan's liquid rocket engines; upgrading the inertial guidance system; developing

# FACTS DENVER AEROSPACE

**Martin Marietta is refurbishing and modifying decommissioned Titan II ICBMs for use as space launch vehicles. The Titan II will be able to lift 4800 lb into low-polar orbit. The Air Force plans an initial launch capability in April 1988 from Vandenberg Air Force Base in California, with subsequent launches continuing into 1995.**

MARTIN MARIETTA

command, destruct, and telemetry systems; modifying Vandenberg Air Force Base Launch Complex-4 West to conduct the launches; and performing payload integration.

The Air Force requires an initial launch capability of a Titan II space launch vehicle in April 1988 from Vandenberg AFB in California, with subsequent launches continuing into 1995.

The Titan II space launch vehicle is designed to provide a low-cost, low-to-medium-weight launch capability for the Air Force. The vehicle consists of two stages, a payload adapter, and a payload fairing. It will be able to lift about 4800 lb into a 100-nautical mile circular polar orbit.

Martin Marietta has built more than 140 Titan II ICBMs, once the vanguard of America's nuclear deterrent force. Titan IIs also were flown as space launch vehicles in NASA's Gemini manned space program in the mid-1960s.

Deactivation of the Titan II ICBM system began in July 1982, with completion scheduled for 1987. Deactivated missiles are stored at Norton Air Force Base in San Bernadino, California. Martin Marietta is responsible for transporting the Titan II ICBMs from California to its facilities near Denver, Colorado, for refurbishment.

**Specifications**

| | | |
|---|---|---|
| First Stage | Length: | 70 ft |
| | Diameter: | 10 ft |
| | Engine Thrust: | 430,000 lb |
| Second Stage | Length: | 40 ft |
| | Diameter: | 10 ft |
| | Engine Thrust: | 100,000 lb |
| Guidance | Inertial with digital computer | |
| | Subcontractor: | Delco Electronics |
| Payload Fairing | Diameter: | 10 ft |
| | Lengths: | 20-to-30 ft |
| | Skin and stringer construction—trisector design | |
| | Subcontractor: | McDonnell Douglas |
| Liquid Rocket Engines: | Refurbished Titan II ICBM engines | |
| | Subcontractor: | Aerojet TechSystems Co. |

*February 1987*

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# TITAN III COMMERCIAL LAUNCH VEHICLE

Martin Marietta is offering a version of its Titan space launch vehicle for commercial satellite launches. The Titan III Commercial Launch Vehicle will consist of a 13.1-foot payload fairing that can accommodate all anticipated commercial requirements. This launch vehicle can deliver 31,000 pounds into low-Earth orbits. The Titan III Commercial Launch Vehicle will be compatible with a variety of specialized upper stages and can be configured for a wide range of orbits, multiple payloads, and complex mission operations.

The Titan III can deploy a single large satellite or two smaller satellites to low-Earth orbits. From low-Earth orbit, each payload would be propelled to its final desired orbit by its own propulsion stage. This mode of operation is similar to that of the Space Shuttle, enabling the Titan III to accommodate spacecraft already designed for launch by the Shuttle.

The Titan III Commercial Launch Vehicle is part of a family of Titans that has been in service for more than 25 years and includes the Titan I and Titan II intercontinental ballistic missiles (ICBM) and Titan II Gemini launch vehicles.

# FACTS COMMERCIAL TITAN, INC.

**The Titan production line at Martin Marietta has been in continuous operation for more than 25 years, currently producing Titan 34D launch vehicles and refurbishing deactivated Titan II ICBMs into space launch vehicles. A Titan IV vehicle is under development. These programs assure Titan production and launch capability into the 1990s.**

MARTIN MARIETTA

Titan III has been the primary launch vehicle for the U.S. Air Force for 20 years and has also been used for missions of the National Aeronautics and Space Administration (NASA). The Titan III had recorded 130 successful flights in 135 operational launches for a 96.3% success rate, making its launch record among the best in the world.

Martin Marietta and its subcontractors continue to operate a launch vehicle production line that is expected to be in operation well into the 1990s. Three Titan space launch systems are currently in various stages of production or development. The major effort is to develop a Titan IV vehicle able to launch payloads for the U. S. Air Force as a complement to the Space Shuttle. Martin Marietta is under contract with the Air Force to refurbish deactivated Titan II ICBMs for use as space launch vehicles. The company also builds the currently operational Titan 34D launch vehicle for the Air Force—a version of the Titan III.

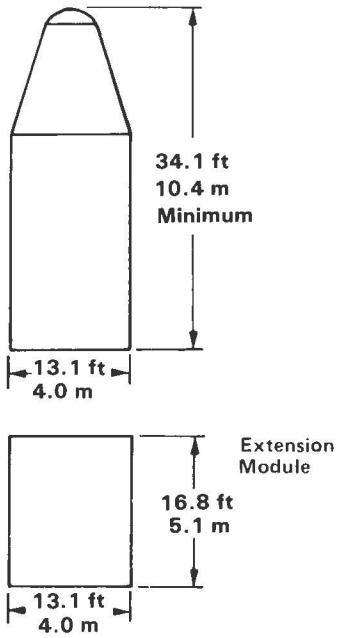
The Titan production line at Martin Marietta's Denver facility not only has been in continuous operation for 25 years, but is capable of handling additional capacity well into the next decade. Capital investments have been made for production and launch facilities for Titan. Four existing operational launch sites are designed for Titan launches, and Martin Marietta has received Air Force approval to use Launch Complex 40 at Cape Canaveral Air Force Station in Florida for commercial operations.

The Titan III commercial launch system consists of two liquid-propellant booster stages with twin solid-propellant rocket motors attached to each side of the core vehicle for additional thrust. The Titan III Commercial Launch Vehicle will use two 5 1/2-segment solid rocket motors.

**The Titan Team**

- **Martin Marietta: prime contractor, systems integration, airframe**
- **Aerojet TechSystems: liquid rocket engines**
- **United Technologies, Chemical Systems Division: solid rocket motors**
- **Delco Systems Operations: guidance systems**
- **Contraves, AG: payload fairing**
- **Dornier System GmbH: Payload Carrier Assembly**

**Titan III Commercial Launch Vehicle Payload Capability**




*September 1987*
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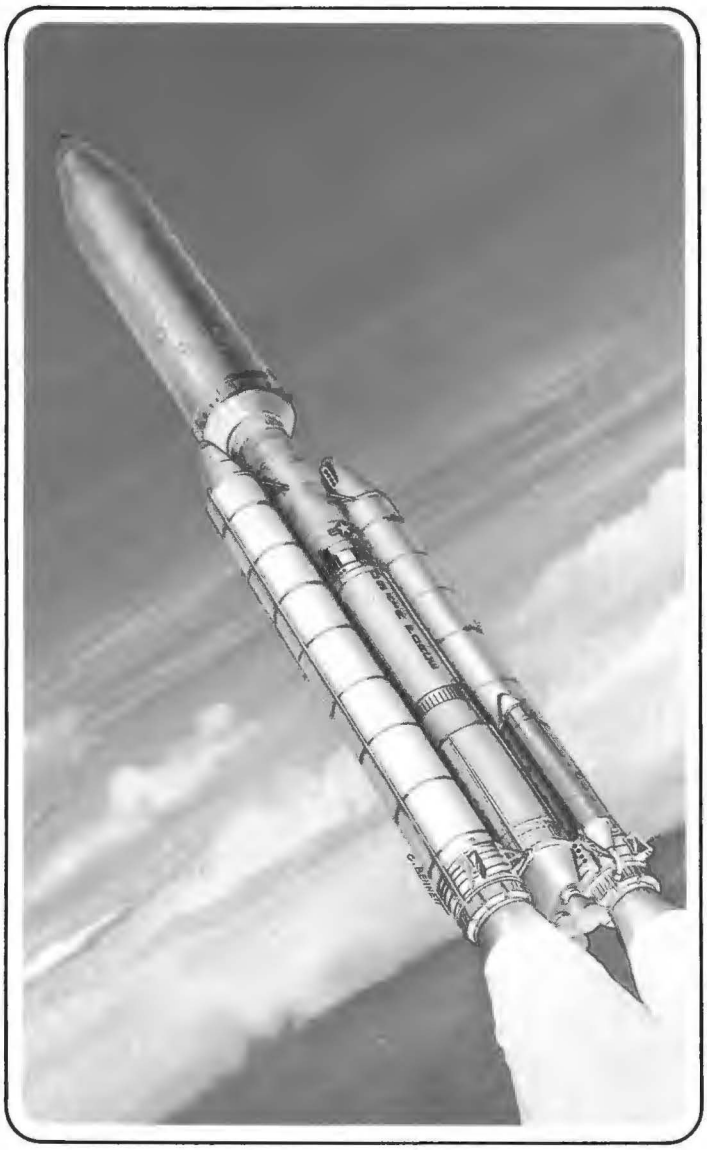


# TITAN IV

The Titan satellite launcher has been the workhorse of the U.S. Air Force space program for more than 20 years. Titan is reliable, versatile, and has a proven performance record.

Martin Marietta is developing the Titan IV expendable launch vehicle to meet the Air Force requirement for 23 new unmanned satellite launchers. The Titan IV is one of the nation's primary launch vehicles—and in some instances, the only launch vehicle—for critical national security payloads.

The Titan IV is the latest addition to a family of Titan launch vehicles that has compiled an unsurpassed record. The Titan III has successfully completed 130 of 135 operational launches since 1967 for a 96.3 percent success rate.

The Titan IV is an improved version of the Titan 34D space launch system, with stretched first and second stages, seven-segment solid propellant rocket motors, a 16.7-foot diameter payload fairing, and three launch configurations—modified G-prime Centaur Upper Stage, Inertial Upper Stage, and no upper stage.

# FACTS SPACE LAUNCH SYSTEMS

**The Titan IV is an integral part of the nation's mixed fleet of expendable launch vehicles and the Space Shuttle. It is the latest addition to a family of Titan launch vehicles that has compiled an unsurpassed success record.**

MARTIN MARIETTA

The Titan IV, with a modified G-prime Centaur Upper Stage, is capable of placing 10,000-pound payloads into geosynchronous orbits—22,300 miles above the Earth. The Titan IV system also is capable of placing 39,000 pounds into a low-Earth orbit at 28.6 degrees inclination, or 32,000 pounds into a low-Earth polar orbit. Titan IV will be launched from Cape Canaveral Air Force Station in Florida, and from Vandenberg Air Force Base in California.

In addition to building the first and second stages of the stretched core vehicle, Martin Marietta provides overall systems engineering/integration, payload integration, and launch services for the Titan IV program.

Martin Marietta has a highly skilled Titan team in place, including the design, development, manufacturing, and flight operations personnel and the subcontractors who brought Titan to its present level of proficiency. That team has worked together since 1964.

## Team Members

Subcontractors:

General Dynamics Space Systems, San Diego, California—Modified G-prime Centaur Upper Stage

Chemical Systems Division, United Technologies Corporation, San Jose, California—Solid Rocket Motors

Aerojet TechSystems Company, Sacramento, California—Liquid Rocket Engines

McDonnell Douglas Astronautics Company, Huntington Beach, California—Payload fairing

Delco Systems Operations, General Motors Corporation, Goleta, California—Inertial Guidance Components

Spacecraft, Inc., Huntsville, Alabama—Instrumentation

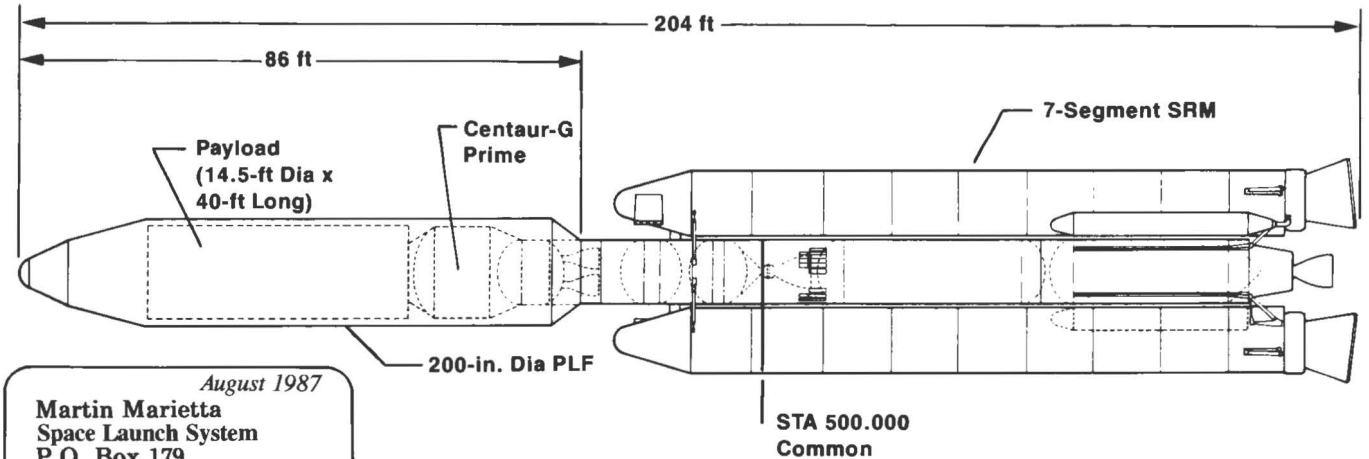
Cincinnati Electronics Corporation, Cincinnati, Ohio—Command Receivers

Associate Contractor:

Boeing Aerospace Company, Seattle, Washington—Inertial Upper Stage

| | Solid Rocket Motors (Two) | Stage One | Stage Two | Centaur Upper Stage |
|---|---|---|---|---|
| Length | 112 ft | 86.5 ft | 32.7 ft | 29.45 ft |
| Diameter | 10.0 ft | 10.0 ft | 10.0 ft | 170 in. |
| Thrust | 1.6-Million lb per Motor | 548,000 lb | 105,000 lb | 33,000 lb |
| Propellants | Solid | Storable Liquid | Storable Liquid | Cryogenic |

**Guidance: Inertial with Digital Computer**
**Payload Fairing: 200-in. Diameter, 56-86 ft Length, Tri-Sector Design, Aluminum Isogrid Construction**




*August 1987*
Martin Marietta
Space Launch System
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# SPACE OPERATIONS SIMULATIONS LABORATORY

The Space Operations Simulations (SOS) Laboratory can support all phases of space program development including: requirements analysis and conceptual design; hardware and software design, development, and verification; flight and ground crew training; extravehicular activity planning, training and systems development; mission timelining; and crew activity planning.

A computer-driven, man-rated moving base carriage simulates a gravity-free environment and provides six-degrees-of-freedom maneuverability under manual or automated control. The carriage can travel 66 feet and the gimbal head can accommodate payloads weighing up to 517 pounds. Hand controllers provide manual pilot control from the carriage itself as in manned maneuvering unit simulations, or from a remote station as in teleoperator maneuvering system simulations with a camera mounted on the carriage. Rendezvous and docking operations can be simulated with both stationary and dynamic targets. Targets can be scaled from 1:1 to 72nd scale. The one-axis target gimbal

# FACTS DENVER AEROSPACE

**The shuttle aft flight deck (AFD) simulator is equipped with fidelity panels with functional switches and indicators, several video monitors, and NASA hand controllers to maneuver the moving base carriage and the remote manipulator arm. The AFD simulator is employed in the definition of control station requirements, the evaluation of controls and displays, and in crew procedures development, familiarization, and training.**

MARTIN MARIETTA

can provide rotation of mockups up to 20 feet, and the computer-driven three-axis target gimbal can accommodate up to 7-foot mockups.

The carriage is currently used in manned maneuvering unit astronaut training for the solar maximum mission satellite repair, evaluations of free-flyer rendezvous and docking maneuvers, spacecraft controllability, and in the assessment of grappler designs and manipulator system concepts.

Manipulator designs can be evaluated early in a project. A camera and manipulator end effector can be mounted on the moving base carriage, which moves in response to a software model of the manipulator design.

The manipulator development laboratory is fully equipped to support the development and testing of remotely controlled manipulator systems (RMS) concepts and designs. The lab contains a quarter-scale, Martin Marietta developed manipulator arm that is capable of simulating the Shuttle RMS for procedural training andd feasibility studies. This manipulator system includes stereo TV, force feedback, back drivability, and position control.

The 6 x 9-foot rear-projection video display system is used in conjunction with the moving base carriage and the three-axis target gimbal to provide a full-mission manned maneuvering unit (MMU) simulation capability. The MMU pilot is positioned in front of the large screen display and provided with MMU controls and displays. With a carriage-mounted camera viewing scale models of the orbiter and its payloads, the MMU pilot can maneuver the carriage to simulate a full MMU mission from long transfers (up to 500 feet), to manuevering in and around the orbiter.

Martin Marietta
Denver Aerospace
P.O. Box 179
Denver, Colorado 80201

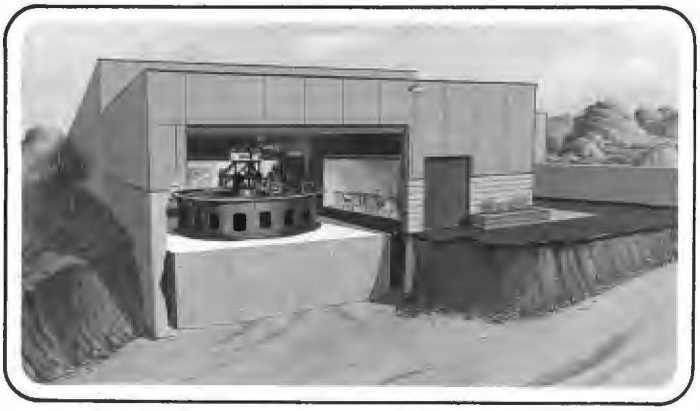
**April 1985**

# RAPID RETARGETING LABORATORY

The Rapid Retargeting Laboratory (RRL) is a national research facility for the Strategic Defense Initiative (SDI) program of the U.S. government. The laboratory contains a rapid retargeting/precision pointing simulator that is designed to duplicate the extreme precision and retargeting performance of SDI surveillance, pointing, and tracking elements, thus providing a low-cost testbed on Earth that simulates the vibration-free environment of space.

SDI space elements will have to be pointed and controlled with unprecedented precision and speed at extreme ranges. Pointing must be extremely precise to enable a quick kill of the target, and retargeting time must be extremely fast to maximize the number of targets a space element can engage. The Rapid Retargeting Laboratory simulator is designed to test these pointing, retargeting, and control systems.

# FACTS SPACE SYSTEMS



**The Rapid Retargeting Laboratory simulator is anchored to the most seismically-stable base on the continent—an underground rock that is 28 miles long, 8 miles deep, and a half-mile wide. This results in a seismic background noise level that is one-millionth of the normal force of gravity.**

MARTIN MARIETTA

In addition to precision pointing and rapid retargeting, SDI payloads must be isolated from the "noise" generated in the spacecraft's main maneuvering body by power supplies, and components such as cooling pumps. The simulator dramatically reduces this effect through the use of a unique "gimbalflex" actuator/isolator system, originally developed by Martin Marietta, that provides vibration isolation in excess of 10,000 to 1.

The simulator is a complete and extremely precise system that can simulate the acquisition, pointing, tracking, and retargeting of SDI space elements under development. Although the simulator does not resemble a spacecraft, all of the functions of one are present in its hardware and software, and are directly applicable and adaptable to SDI space elements. Because the RRL simulator is flexible enough to simulate a broad range of space system configurations and scenarios, it minimizes the development gap between a technique tested and proven on the simulator and the hardware and software needed for a flight system.

Structural characteristics of a space system are simulated by the flexible two-body simulator. Target position, velocity, and acceleration are simulated by the target simulators. The aft body of the simulator is driven by a 15-foot diameter linear motor, and the graphite epoxy payload structure is driven by the gimbalflex and by the outer air bearing. The gimbalflex also isolates aft-body noise from the sensitive payload. The target acquisition sequence incorporates SDI requirements for coarse tracking followed by handover to fine tracking. Retargeting performance of the space system being simulated is fully characterized by the simulator system.

The entire simulator is controlled by seven high-speed, high-capacity computers capable of processing information from 256 different sources approximately 2000 times a second. All operations are performed within a temperature-controlled, anechoic environment on an extremely quiet seismic pier base to ensure reliable collection of data uncontaminated by outside error sources.

The location of the Rapid Retargeting Laboratory at Martin Marietta facilities near Denver, Colorado, is ideal because of a unique rock formation. The laboratory is anchored by a concrete pier to an underground rock imbedded in silt that is 28 miles long, 8 miles deep, and a half-mile wide. This makes it the most seismically quiet location on the continent, with a seismic background noise level that is one-millionth of the normal force of gravity.

The Rapid Retargeting Laboratory is a critical resource in SDI systems development, and can be interfaced directly with other national SDI test facilities. Researchers will be able to evaluate their concepts and verify their designs before prototype or full-scale development at dramatically lower costs than building flight units and testing them in space. Industrial concerns, universities, research organizations, and government agencies will be able to contract through the Strategic Defense Initiative Organization to test their systems at this Denver facility.

*August 1987*
**Martin Marietta**
**Space Systems**
**P.O. Box 179**
**MN-1200**
**Denver, Colorado 80201**

Martin Marietta

# Denver Aerospace

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# Denver Aerospace — An Overview

Since the first buildings rose among the Rocky Mountain foothills in the mid-1950s, Martin Marietta's operations near Denver, Colorado, have grown into one of the nation's largest and most active private space and defense centers. Its accomplishments include such projects of the space age as the Space Shuttle external tank, Titan space boosters, the Viking missions to Mars, Manned Maneuvering Unit (MMU) space propulsion backpacks for Shuttle astronauts, and Skylab. Participation in the nation's defense has progressed from the Titan I ICBM to the assembly and flight testing of the Peacekeeper (MX) ICBM.

Performance on past major programs has helped the business base for Denver Aerospace to grow steadily and diversify to over 400 currently active contracts.

This work includes the development of complex computerized systems used in controlling operations that range from Space Shuttle launch preparations to unmanned exploration of distant planets and the modern electronic battlefield. It covers the design and assembly of sophisticated research satellites and their instruments, as well as vehicles to launch them and move them about in space. And, as one of the nation's principal defense contractors, Martin Marietta is helping to design and build new strategic systems.

Martin Marietta is involved in projects which will increase access to space for commercial enterprises and design the intelligent robots of the future. The company also has a major role in the National Aeronautics and Space Administration's (NASA) manned space station program, and is studying several systems to be used with the space station.

Martin Marietta Denver Aerospace is headquarters for the Space Systems, Strategic Systems, Space Launch Systems, Defense Systems, and Space Station organizations. Collocated with the company in Denver are many of the employees of Martin Marietta Information & Communications Systems, formed in August 1984 to design, build, and integrate advanced information processing and communications systems.

The main Denver Aerospace facility south of Denver has grown physically over the years. Today, it includes more than 40 sophisticated laboratories, as well as computerized engineering design, manufacturing, and administrative facilities. Some of the outstanding features of the complex are:

* Laboratories for research and development of optics, spacecraft guidance and control equipment, metallurgy, microelectronics, and atmospheric sciences.
* A launch vehicle manufacturing and assembly facility, in which more than 400 Titan space launch vehicles and ICBMs have been built.
* A space simulation laboratory—a huge test chamber where full-sized spacecraft are subjected to the vacuum, heat, cold, and intense sunlight of space.
* Command, control, and communications ($C^3$) laboratories in which advanced methods

Main Denver Aerospace facility

Space Operations Simulator Laboratory

Reverberant Acoustic Test Facility

and equipment for correlating and graphically displaying data are developed.

* A fine-pointing laboratory, set on seismically stable bedrock, to test extremely precise mechanisms for aiming instruments and spacecraft systems.
* Dust-free spacecraft assembly bays for full-size spacecraft and their components.
* A four-story anechoic chamber for testing advanced antenna designs and other space communications equipment.
* A reverberant acoustic test facility which simulates the vibration environment of the Space Shuttle in a clean-room test chamber large enough to accommodate cargo bay-sized payloads.
* A space operations simulator laboratory which enables practice flights of MMU missions by astronauts, development of remote manipulator techniques, and Shuttle payload integration studies.
* Offices and laboratories for development of advanced software, artificial intelligence, and robotics. In 1983, Denver Aerospace was designated the "software center of excellence" for the Corporation. An expansion of facilities, programming tools, and staff represents a commitment to placing Denver at the vanguard of this key technology in modern system design.

Denver Aerospace is one element of Martin Marietta Corporation, an aerospace and technology company headquartered in Bethesda, Maryland. The Corporation designs, manufactures, and manages systems and products in the fields of space, defense, electronics, communications, information management, energy, and materials.

Other Martin Marietta aerospace operations, in addition to those at Denver, are in Orlando, Florida; New Orleans, Louisiana; and Baltimore, Maryland.

Orlando Aerospace designs and builds tactical weapon systems, including the Pershing II missile. Other projects include guided projectiles, antiarmor weapons, and communication, fire control, and target identification and acquisition systems. Among major programs currently underway are the Target Acquisition Designation Sight and Pilot Night Vision Sensor, the Air Defense Antitank System, the Copperhead laser-guided projectile, and the Low Altitude Navigation and Targeting Infrared for Night navigation and targeting system.

Michoud Aerospace, located in New Orleans, produces the external fuel tank for the Space Shuttle under contract to NASA. The giant tanks are assembled under one roof in a structure covering 43 acres, and shipped by NASA barge to the Kennedy Space Center in Florida and to Vandenberg Air Force Base in California. Michoud also is assisting Denver in the conduct of space station definition and preliminary design.

At Baltimore, aerospace and defense components are manufactured, including a vertical launch system produced initially for the Navy, thrust reversers for commercial jet aircraft, and B1-B bomber parts. Baltimore also is involved in research and development of antisubmarine warfare systems, and is working with Denver on the hard mobile launcher for the small ICBM.

Denver Aerospace was perhaps the first of many high technology operations to locate along the Colorado Front Range area. It continues to be influential in the evolution of the area into one of the nation's principal centers of advanced technology. Martin Marietta's steady growth has maintained it as a major local revenue source through payroll, procurements, and taxes.

Now into its second quarter century of operation, Denver Aerospace has built a physical plant and a range of capabilities to serve its large business base of today and as the foundation for tomorrow. The direction of that future can be seen in an overview of projects currently in progress.

Near-field antenna test facility

Viking being lowered into deep-space environment test chamber

Advanced command, control, and communications lab

# Space

Space Shuttle Challenger

## SPACE SHUTTLE

The Space Shuttle, man's first reusable launch vehicle, makes possible the routine use of space for scientific, defense, and commercial needs. Its service was inaugurated on April 12, 1981. Over the next two decades, a fleet of four orbiters will carry out missions at a steadily increasing frequency, launching and landing at Kennedy Space Center in Florida and Vandenberg Air Force Base in California.

The Shuttle has three major elements: the orbiter, the external tank, and two solid rocket boosters. The external fuel tank, 154 feet long by 28 feet in diameter, is the largest element and the largest single space vehicle component ever built. The tank is the structural backbone to which the orbiter and solid rocket boosters are attached. Its 528,000 gallons of liquid hydrogen and liquid oxygen fuel are consumed by the orbiter's three main engines in about eight and a half minutes of flight. The only nonreusable element of the Shuttle, the external tank is jettisoned to break up in the atmosphere and fall safely into the ocean.

Two reusable solid rocket boosters augment the thrust of the Shuttle's main engines during the first two minutes of powered flight. After burnout, the boosters are lowered by parachutes into the ocean for retrieval, refurbishment, and reuse.

As a partner to both the Department of Defense (DOD) and the National Aeronautics and Space Administration (NASA), Martin Marietta has extensive responsibilities for both flight hardware and ground support systems for the Shuttle. These include:

### Flight Hardware

* The external fuel tank design, development, assembly, testing, and production in New Orleans by Michoud Aerospace. Michoud has been able to reduce the tank's weight by over 10,000 pounds and reduce

Space Shuttle external fuel tanks at the Michoud Assembly Facility

its cost by $98 million for the first 54 tanks. It has developed production facilities into an efficient operation that will be able to deliver 24 or more tanks per year by 1988.

* Reaction control system fuel tanks, which provide pressure-fed propellants to the orbiter's thrusters while in orbit and during reentry.
* Caution and warning electronics to alert the crew with alarms and visual warnings if any malfunction occurs in the orbiter's many complex systems.
* Pyrotechnic initiator control systems for ordnance mechanisms aboard the Shuttle, such as exploding bolts that permit jettison of the solid rocket boosters and external tank.
* The solid rocket booster recovery system, which uses the largest parachutes ever built to lower the boosters into the ocean for retrieval and refurbishment.

Space Shuttle west coast launch complex at Vandenberg Air Force Base, California

## Ground Operations

* Checkout, control, and monitor subsystems (CCMS) in the launch control centers at Kennedy Space Center, Johnson Space Center, and Vandenberg Air Force Base. CCMS performs data processing and controls and monitors all Shuttle systems up to launch.
* Ground support systems integration for the Air Force, which encompasses assisting the Air Force in the overall design and construction of the Shuttle launch, landing, and refurbishment site at Vandenberg Air Force Base.
* Payload integration for military payloads launched by the Air Force from either California or Florida.
* Design of the automated operations at Kennedy Space Center which store and load liquid propellants into the Shuttle's external tank.
* Refurbishment and preparation of retrieved solid rocket booster recovery system parachutes for each launch.
* A state-of-the-art digital intercom system at Kennedy Space Center that links the Space Shuttle launch pad, mobile launch platform, and key operational buildings. It will be used to support prelaunch, launch, and postlaunch activities and hazardous activities.

In addition to basic Shuttle systems, Martin Marietta is engaged in projects to enhance the performance of the Shuttle.

* The Manned Maneuvering Unit (MMU) backpack propulsion system gives Shuttle astronauts the ability to move freely in space. Its cold nitrogen gas propulsion is directed by the astronaut's manipulation of two hand controls for straight line or rotational movement in any direction. As standard Shuttle equipment, the MMU enables in-space inspection and servicing of the orbiter or satellites, deployment of payloads, and assembly of large structures in space.

Astronauts train for MMU flights at a space operations simulator at Denver Aerospace. Here, a computer-controlled structure simulates movement in space according to the astronaut's use of the hand controls and "flies" the astronaut within a large room. The facility was used, for example, in practice for two satellite retrieval and repair missions in 1984.

* Tethered Satellite System—a system for deploying and retrieving a reusable satellite from the Shuttle orbiter with a line 60 miles long. Martin Marietta is developing the concept under a joint agreement between NASA and the Italian government. When operational in 1987, the system will enable exploration of parts of Earth's atmosphere too low to orbit and too high for aircraft and provide an economical means of scientific and Earth resources investigations. The system can be deployed above the orbiter as well.

* Modifications to the Shuttle system to increase its payload and mission capabilities, such as design of an aft cargo carrier (ACC) mounted to the external tank. Martin Marietta has conducted a conceptual design study of the ACC. By carrying the tank and attached cargo carrier into orbit, the Shuttle's payload volume can be increased substantially. Other designs include unmanned Shuttle-derived cargo vehicles which use modified Shuttle elements to lift very large payloads into orbit.

* Infrared Imaging of Shuttle (IRIS) instruments, which measured from an aircraft the temperatures across the orbiter's underside during reentry. The data are used to evaluate performance of thermal protection materials.

Palapa/Westar satellite recovery mission (STS 51-A)

Tethered Satellite

## SPACE STATION

Man's first 25 years in space have been characterized by a sequence of successful unmanned and manned space flight programs. These programs have contributed vast stores of knowledge about the world and universe, and have led to the development of many new products and techniques to benefit mankind. Now, NASA is taking the next logical step in space exploration—development of a permanently manned space station.

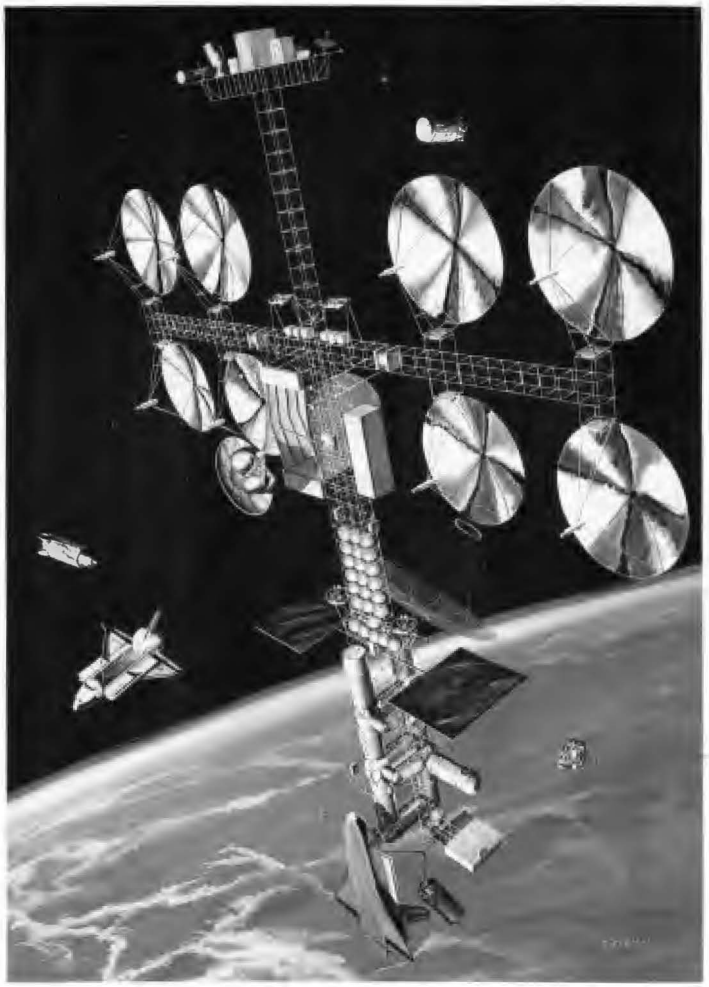
President Reagan laid the groundwork for building a space station in early 1984, when he directed NASA to develop the orbiting workshop and research center within a decade. Responding to the president's directive, NASA has embarked on a three-year program to define what it intends to build and how it will go about it.

Plans call for the space station to be a multipurpose, permanent system in low-Earth orbit. It will consist of a manned base and two or more free-flying platforms for Earth observation, materials processing, and astronomy experiments.

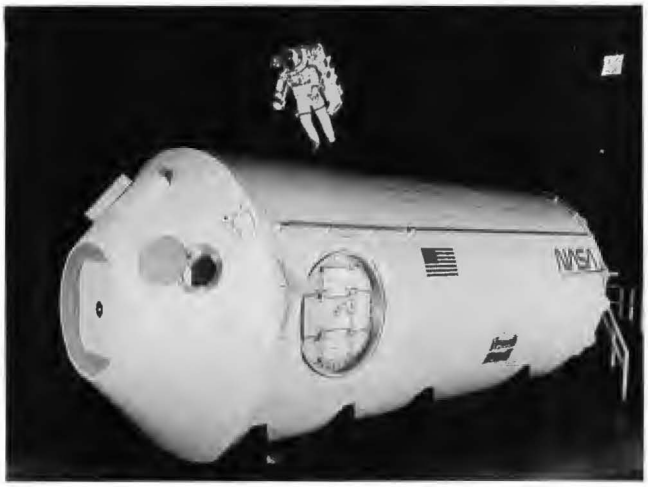
Initially, the station will be equipped to accommodate six to eight engineers, scientists, technicians, or other specialists. Each crew will spend approximately 90 days in orbit before they are replaced by a new crew.

NASA has assigned work packages to four of its centers covering all aspects of space station development. Denver Aerospace is one of two industry teams selected by NASA's Marshall Space Flight Center for a competitive contract which includes definition and preliminary design of the space station's common modules, which will be equipped as laboratories and living quarters.

Under the contract, the company also is studying the station's environmental control and life support systems and an auxiliary propulsion reboost system, and will develop methods for docking and handling orbital maneuvering and orbital transfer vehicles.



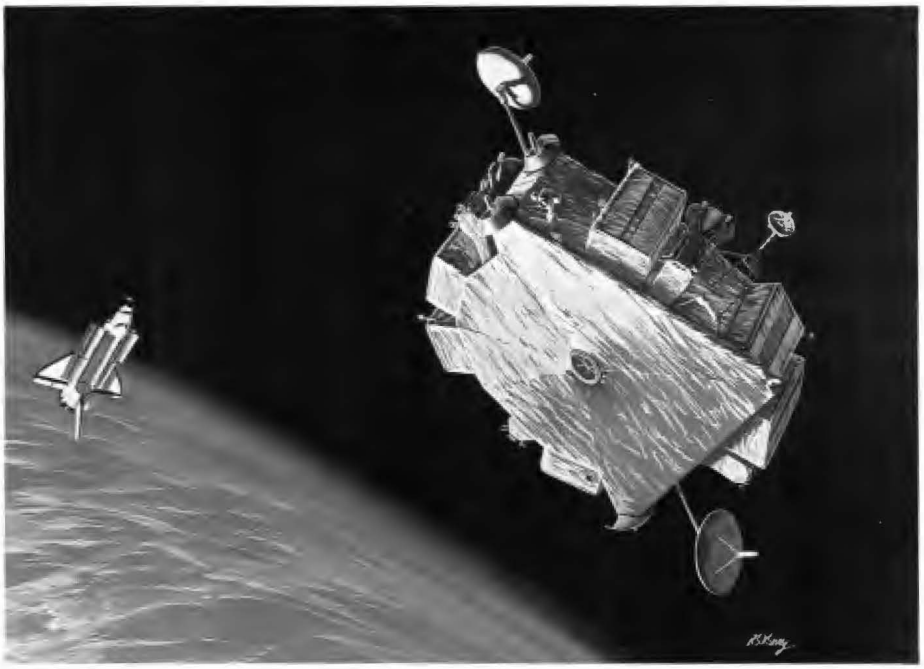
Space Station



Space Station common module mockup

## Orbital Maneuvering Vehicle

The orbital maneuvering vehicle (OMV) is a reusable, free-flying spacecraft that is expected to play a large role in building and maintaining the space station. Operated by remote control from a ground station after deployment from the Space Shuttle or space station, the OMV would move satellites and other orbiting objects from place to place in space. The OMV would extend the Shuttle's capabilities for satellite delivery, retrieval, and servicing to about a thousand miles above the Earth.



Orbital Maneuvering Vehicle

Orbital Transfer Vehicle

## Orbital Transfer Vehicle

The orbital transfer vehicle (OTV) is a highly sophisticated space transportation vehicle being studied by Martin Marietta under contract to NASA. The OTV initially would be an unmanned upper-stage rocket vehicle used to transfer payloads in space from lower to higher orbits, usually geosynchronous orbit—22,300 miles. Designed to be reusable, the OTV could be deployed either from the Space Shuttle or space station. NASA ultimately hopes to develop a manned vehicle capable of ferrying a crew capsule to and from geosynchronous orbit.

## LAUNCH AND SPACE PROPULSION SYSTEMS

### Titan

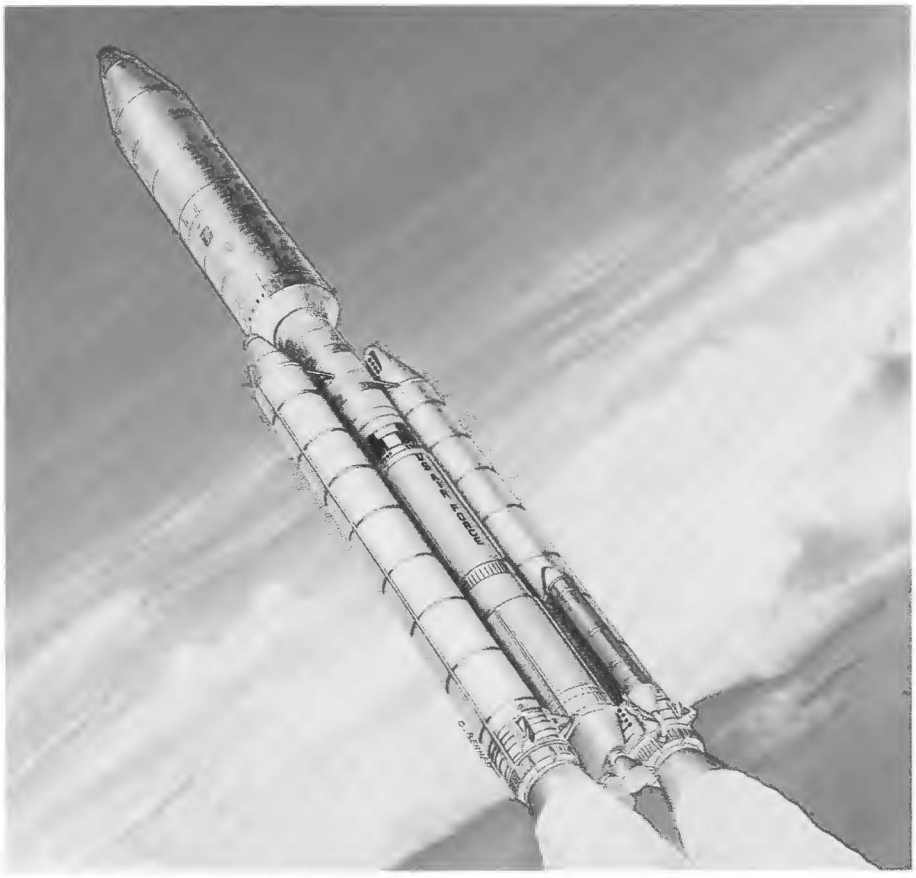
The latest operational version in the highly successful line of Titan space launch vehicles designed and built by Denver Aerospace is the Titan 34D used by the Air Force to launch military satellites. First flown in October 1982, subsequent 34D launches have brought the Titan success record to 97 percent of more than 130 operational launches.

Like its predecessors, the Titan 34D is a two-stage liquid-propellant rocket with twin solid-propellant boosters. It can be flown with different-size payload sections and added propulsion stages. Alone, the current Titan can lift nearly 16 tons into low-Earth orbit. Used with a version of the Centaur upper stage, the Titan will be able to deliver payloads weighing up to 10,000 pounds to geosynchronous Earth orbit. Titan IIIE/Centaur combinations previously launched NASA planetary missions, including Viking and Voyager.

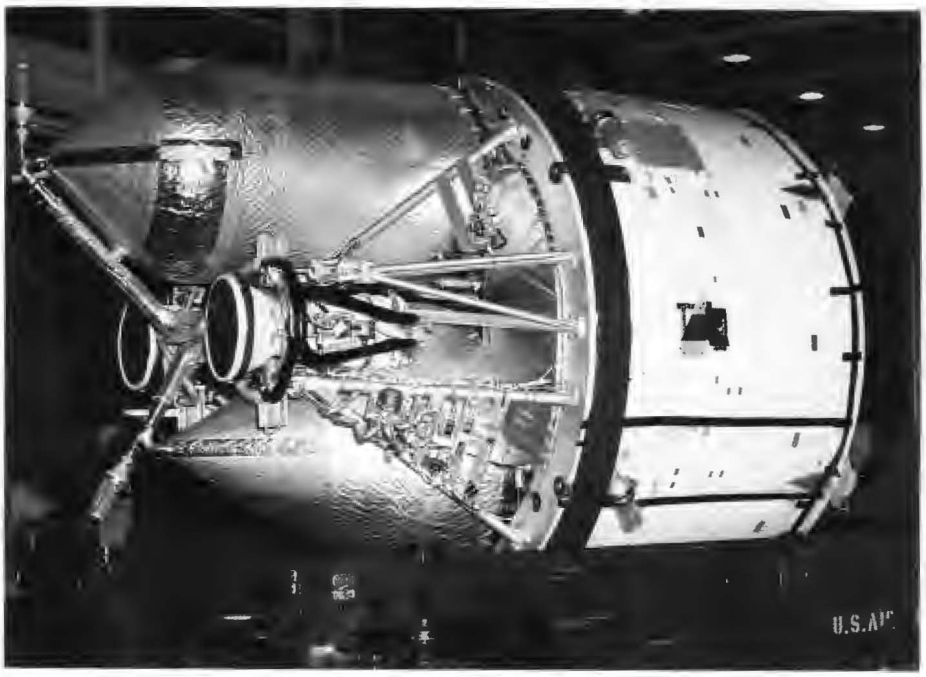
### Titan 34D7

Denver Aerospace is developing an improved expendable launch vehicle, the Titan 34D7, to meet the U.S. Air Force's requirement for 10 new launch vehicles as a complement to the Space Shuttle. This Titan 34D7 will have stretched first and second stages, seven-segment solid propellant rocket motors, a 16.7 foot diameter payload fairing, and a Centaur G-prime upper stage. It will be capable of placing 10,000 pound payloads into geosynchronous orbit. The Air Force plans to launch two Titan 34D7s a year, beginning in late 1988.

Titan 34D



Titan 34D7



Transtage

## Transtage

The Transtage, designed and built by Martin Marietta, is a storable liquid bipropellant upper stage used in conjunction with Titan launch systems. It is used as the fourth stage of a Titan system to boost single or multiple payloads weighing up to 4,200 pounds into geosynchronous orbit. With its ability for multiple starts, Transtage has deployed as many as eight satellites during a single mission. Numerous U.S. satellites in synchronous equatorial orbit were placed there by Transtage. Since 1963, when the first contract to build a Transtage was awarded to the company, the Transtage has flown over 30 operational missions with only one failure.

## Transfer Orbit Stage

Denver Aerospace and Orbital Sciences Corporation are developing the Transfer Orbit Stage (TOS), a solid-propellant upper stage designed to move satellites from low-Earth orbits to higher orbits and planetary escape trajectories. The TOS has the capability of placing 6,000- to 13,100-pound payloads into geosynchronous transfer orbit. Also under development as a stand-alone stage or an add-on to the TOS is the Apogee and Maneuvering Stage, a liquid bipropellant propulsion module. When ready in 1986, TOS will meet the needs of commercial users for affordable and dependable space propulsion, as well as future NASA research missions. A TOS-equipped satellite can also be launched by Titan.

Transfer Orbit Stage

## SPACECRAFT AND INSTRUMENTS

### Venus Radar Mapper

In 1988, an unmanned spacecraft will be launched on a mission to obtain images of the cloud-covered surface of Venus from orbit around the planet. A clear view of Venusian topography will be made possible by synthetic aperture radar to which clouds are transparent. Denver Aerospace is responsible for design and assembly of the spacecraft which will map 90 percent of Venus' surface in a 243-day mission. The probe also will measure Venus' gravity field to determine the planet's density and distribution of elements.

Venus Radar Mapper

### Faint Object Spectrograph

The Hubble Space Telescope, which will provide a view of the universe many times improved over the most powerful Earth-based telescopes, is scheduled for launch by the Shuttle in 1986. A faint object spectrograph (FOS) built by Martin Marietta is one of five major instruments contained in the telescope. The spectrograph will enable astronomers to observe the properties and motions of stars, galaxies, and other celestial objects up to 14 billion light years distant and 50 to 100 times fainter than any observed before.

Space Telescope

### Galileo Instruments

In 1986, NASA will launch an unmanned spacecraft which will greatly expand knowledge of Jupiter. Called Galileo, the spacecraft will drop a probe packed with instruments by parachute into Jupiter's turbulent clouds. The probe is expected to transmit for about an hour during its descent before being crushed by immense pressure.

Denver Aerospace has designed and built three instruments carried on the probe. A nephelometer and an atmospheric structure instrument will measure the physical makeup of Jupiter's clouds and atmosphere. The third instrument, a net flux radiometer, will measure the radiant energy that exists in the atmosphere. In addition, the company is responsible for the attitude and articulation control system to orient the spacecraft during its flight to Jupiter.

Space Sextant

## Space Sextant

Martin Marietta designed and built an Autonomous Navigation and Attitude Reference System for the Air Force that enables Earth-orbiting satellites to determine their own position in space and perform orbital navigation. The space sextant frees satellites from dependence on tracking signals from Earth, which are vulnerable to jamming.

Two gimbaled telescopes inside a spherical shell locate astral reference points while an onboard computer uses the angles between the reference points to determine the satellite's position. The sextant can compute the position to within a mile in 10 minutes and to within a few feet in 24 hours—far less time than has been possible with ground tracking stations.

Galileo

## L-SAT Fuel Tanks

The European Space Agency will launch, in forthcoming years, a series of large "Olympus" communications satellites to serve its nine member nations. Under a contract to British Aerospace, Martin Marietta has designed and is producing titanium propellant tanks that will supply fuel to thrusters that control the Olympus satellites' orientation in space.

# Strategic Missile Systems

Peacekeeper silo launch

Peacekeeper in silo


Peacekeeper emplacer

## Peacekeeper

In 1979, full-scale development was announced of a new ICBM system to be built in response to growing numbers and accuracy of Soviet strategic weapons. The Peacekeeper is larger, with greater range and accuracy, than existing one- and three-warhead Minuteman missiles.

The missile is a four-stage weapon capable of delivering ten independently targetable warheads. It is the nation's first ICBM that is "cold launched" from a supporting canister, using gas pressure in the base of the canister to eject the missile before ignition of the stage I rocket motor.

As one of the principal associate contractors, Martin Marietta is responsible for the assembly, test, and system support for Peacekeeper development. This includes overall engineering support to the Air Force in the design of the missile and the total system, and for the flight test and evaluation program at Vandenberg Air Force Base. All of the test flight program's initial nine launches, including the first launch from an underground silo in August 1985, have been successful.

The company also designed and assembled the instrumentation and flight safety equipment carried in the flight test missiles; designed a wide array of equipment for handling the missiles and components; and established design requirements for facilities at Vandenberg to assemble and check out test missiles. Martin

Marietta currently assembles and launches the test missiles at the base.

Martin Marietta also has contracts for the design and construction of the missile emplacer to place Peacekeepers in modified Minuteman silos. Before full-scale development, Denver Aerospace developed and tested concepts for mobile, land-based deployment methods and conducted early design studies for the Air Force.

## Small ICBM

The small intercontinental ballistic missile (small ICBM) is a new single-warhead missile under research and development by the Air Force. Its deployment was recommended by the President's bipartisan Commission on Strategic Forces, along with Peacekeeper deployment, as a vital addition to the nation's strategic forces.

Scheduled to become operational in 1992, the small ICBM would weigh less than one-sixth of the Peacekeeper. Its size would provide flexibility in basing, including mobility.

Denver Aerospace, as assembly, test, and system support contractor for the small ICBM, has a major role in the program. The company will design, build, and test the small ICBM test launcher and missile handling equipment, instrumentation and range safety system, and post-boost vehicle and shroud. Martin Marietta also is responsible for assembly and flight test of the missile from Vandenberg Air Force Base, and for system support activities. Twenty two small ICBM test flights are planned, beginning in early 1989, with an initial operational capability planned for late 1992.

## Hard Mobile Launcher

The new small ICBM could be based in mobile launchers, in "hard" fixed silos, or a combination of both. One basing concept under active study by the Air Force is hard mobile basing, and Denver Aerospace has a contract to perform design feasibility studies and build a mobility test vehicle for a hard mobile launcher. The mobility test vehicle was demonstrated to the Air Force for the first time in September 1985 by Martin Marietta and the Caterpillar Tractor Co., its teammate on the contract. The hard mobile launcher, which will protect, transport, and launch the missile, will be capable of both on- and off-road operation traveling at speeds of up to 50 miles per hour.

Small ICBM full-scale mockup

Hard mobile launcher mobility test vehicle

# A Look Back

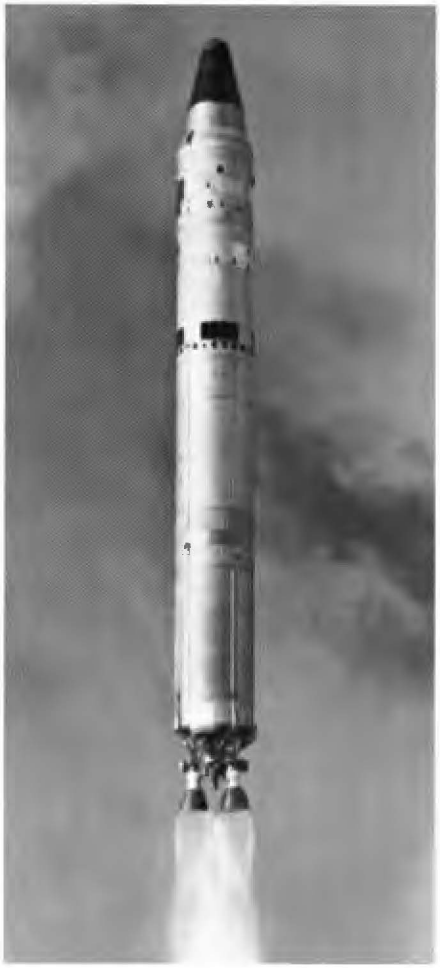
It was May 3, 1961, when the Air Force Titan I intercontinental ballistic missile (ICBM) rocketed skyward, becoming the first in a quarter century of successful Denver Aerospace programs. Titan I was Denver's initial product and for several years, its sole product.

On the heels of Titan I's success, Martin Marietta was chosen by the Air Force to design and build the larger and more powerful Titan II, which replaced Titan I in 1965. The missile's high degree of reliability resulted in its selection by NASA for use in the Gemini manned space flight program.

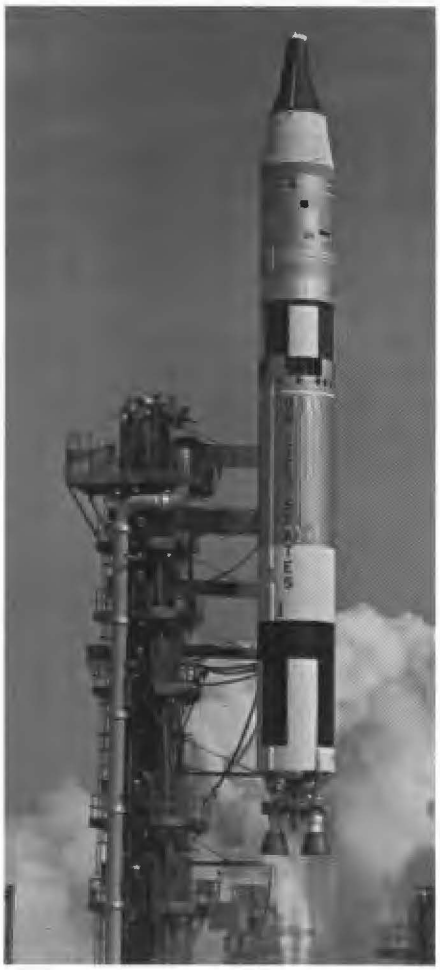
Denver-built Titan IIs powered ten manned and two unmanned missions into space by the time the Gemini program concluded. Martin Marietta's role as a prime contractor in the nation's expanding space exploration program was firmly established.

As early as 1962, Denver Aerospace had begun development of Titan III as the next generation space launch vehicle for the Air Force. Titan III eventually became a flexible "building-block" family of launchers used by both NASA and the Air Force to conduct much of the nation's successful space program over the next two decades. The current model is the Titan 34D.

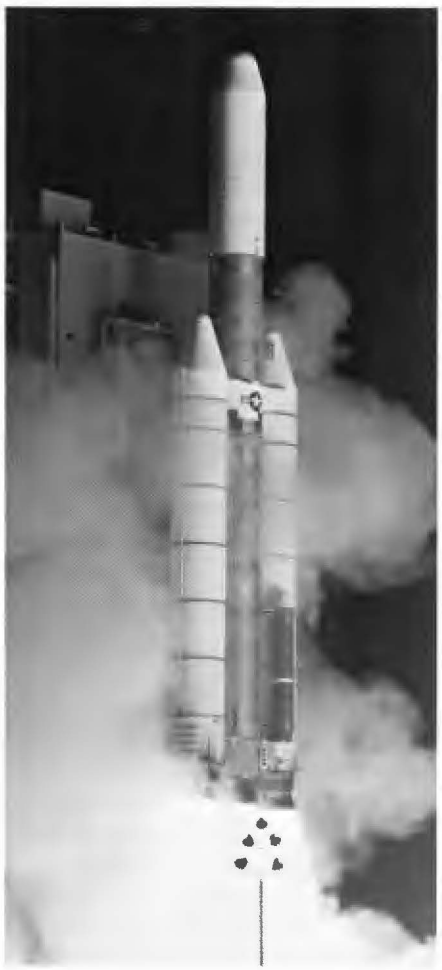
In 1966, the Denver facility was assigned key responsibilities for Skylab, the nation's first manned space station. Martin Marietta outfitted and tested



Titan II intercontinental ballistic missile



Titan/Gemini



Titan III

Skylab


X24-A aircraft

Viking on Mars

The Viking Mars lander

Skylab's multiple docking adapter which contained numerous experiments and was the astronauts' access to the space station. The company also assisted NASA with systems integration and engineering of Skylab experiments, and produced control and display equipment for Earth resources experiments. Launched in 1973, Skylab successfully relayed a wealth of information about the Earth's upper atmosphere and resources.

In the late 1960s and early 1970s, Martin Marietta developed two test aircraft, the X24-A and X24-B, to study the aerodynamics of lifting body aerospace vehicles. Lifting body research such as this was important in the design of the Space Shuttle orbiter.

Few followers of space exploration will forget 1976, when two unmanned spacecraft—Viking I and Viking II—landed on the surface of Mars at the end of a 400-million-mile journey that began in Denver. Not only were

the twin spacecraft/landers and scientific experiments designed, built and tested by Martin Marietta, the Vikings were also launched by Denver-built Titan IIIE/Centaurs, and Martin Marietta personnel conducted the mission operations with NASA.

The Viking mission's performance far exceeded anyone's anticipation. Required by NASA to work for 90 days, one of the Vikings continued operating for more than six years in a climate characterized by extreme temperatures and dust storms. This extraordinary chapter in space exploration finally ended in May 1983 when weakened batteries ceased the transmission of data and photos by Viking I.

The spectacular Mars probe was quickly followed by further U.S. exploration of the outer planets of the Solar System. In 1977, Titan IIIs launched a pair of unmanned Voyager spacecraft to Jupiter, Saturn and beyond. Martin Marietta built the Voyager's propulsion system and associated control electronics.

Denver Aerospace was awarded in 1973 a contract to design and build a giant external tank to fuel the Shuttle from launch into space. Subsequent contracts made Denver the second largest contractor for NASA's Space Shuttle program.

SCATHA (spacecraft charging at high altitudes), a research satellite designed and built by Martin Marietta, was launched by the Air Force in 1979. Its purpose

SCATHA high-altitude orbiting satellite

was to investigate the static electric charging of satellites which at times has caused failure of electronic equipment. SCATHA continues to provide high-altitude environmental data useful for designing spacecraft of the future.

In space, the sun is routinely used as a source of electrical power. Martin Marietta was able to apply much of its knowledge of spacecraft power systems to terrestrial use at the start of the 1980s. Solar power was put to use in its purest form in Saudi Arabia by a photovoltaic system designed and built in Denver. The unit converts sunlight directly into electricity used by two communities near Riyadh. A similar facility began supplying power for Sky Harbor Airport in Phoenix, Arizona, in 1982.

The United States' first large-scale commercial solar thermal central receiver power facility near Barstow, California, uses more than 1,000 mirror heliostats and automated sun-tracking controls built by Denver Aerospace. The facility began operation in 1981, as did a smaller version near Almeria, Spain.

In the 1970s, Martin Marietta continued to work on design of strategic missile systems as part of the U.S. nuclear deterrent forces. This work culminated in the company's key role in development of the Peacekeeper system and design and development of a small ICBM and a hard mobile launcher.

Heliostats

Photovoltaic array

# A Look Ahead

As Denver Aerospace begins its second quarter century, advanced technologies used in the space program, computer systems and software, and system integration are becoming increasingly important areas of endeavor. Among key technologies being developed by the company are robotics, artificial intelligence, and orbital fluid management.

Building on its experience in automated systems for unmanned spacecraft, Denver Aerospace is developing a new generation of artificially intelligent robots for industrial, military, and space applications. This technology is expected to play an important role in building and operating a permanent, manned station in space.

The company is involved in a wide range of programs dealing with artificial intelligence, image understanding, autonomous systems, and associated technologies. Under one contract, it has developed an autonomous land vehicle (ALV). The land-roving, robot vehicle will be used as a national test bed for industry and university developments in artificial intelligence and advanced computer architectures.

The company also has developed a test bed for intelligent task automation that is configured to perform autonomous quality control inspections of machined parts. It uses artificial intelligence and advanced image understanding techniques.

Another critical technology under active development at Denver Aerospace involves management of propellants and other fluids in the low-gravity environment of space, which will be necessary for resupply and servicing of satellites, telemaneuvering systems, small platforms, and orbital transfer vehicles. The company's extensive capabilities include the design, fabrication, assembly, and testing of propellant storage and loading systems for space applications.

Autonomous Land Vehicle


Robotic device checking aircraft bulkhead

Remote manipulator system for payload integration studies

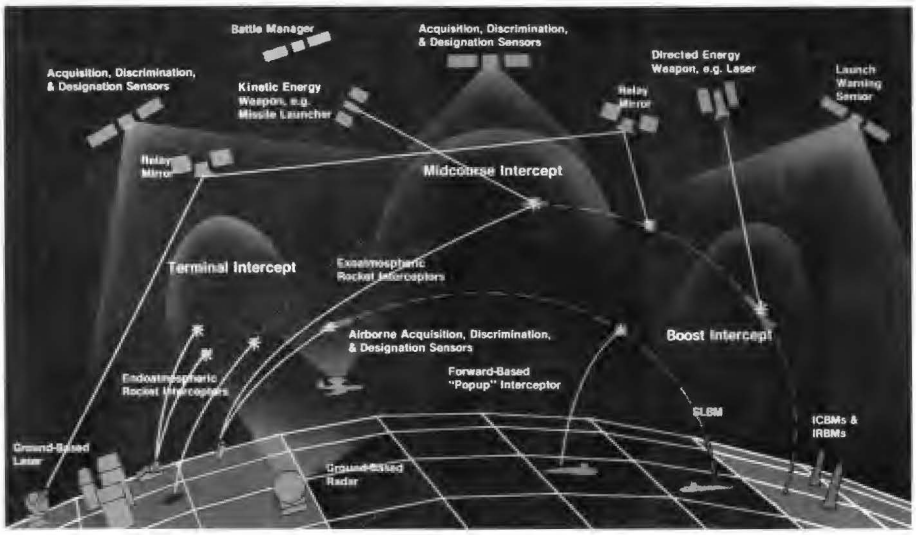
In January 1985, a Martin Marietta-built experiment provided one of the first demonstrations of technology for resupplying propellants to spacecraft or a space station. The experiment, flown aboard the Space Shuttle, demonstrated that propellant tanks containing complex surface tension devices can be successfully filled and emptied in a low-gravity environment.

Among other technologies being studied and developed at Martin Marietta are advanced optics, radiation-hardened microelectronics, very high speed integrated circuitry, spacecraft guidance and control equipment, fine-pointing and tracking systems, and large deployable space structures.

Storable fluid management demonstration on Space Shuttle mission 51-C

A major emerging research effort, in which Denver Aerospace is heavily involved, is the Strategic Defense Initiative (SDI). SDI research focuses on methods by which the United States and its allies could defend themselves against a ballistic missile attack.

SDI involves a number of different defensive weapon concepts, both space-based and ground-based; a large SDI architecture definition; battle management command, control and communications ($C^3$); and new, innovative technological concepts. The types of weapons being studied include kinetic energy weapons and directed energy weapons. The SDI effort also involves an overlay of the logistical and launch support servicing concepts to support any architecture.




Conceptual ballistic missile defense system

Denver Aerospace has been assisting the SDI organization in defining and evaluating SDI system architectures. The company has one of five competitive contracts to conduct a detailed definition study of various system architectures, including technological and functional requirements for the systems and methods to resolve several technical issues.

Under a separate contract, the company is studying concepts for an acquisition, tracking, and pointing platform to be used in a ballistic missile defense system. The study is concentrating on a variety of concepts for a directed energy weapon that could be deployed to intercept missiles in their boost phase.

Denver Aerospace also is conducting a concept definition study of a space-based kinetic energy weapon, a nonexplosive projectile propelled to hypervelocity by chemical propellants that could destroy, by impact force, a ballistic missile in boost and exoatmospheric phases.

In addition, the company is involved in several studies related to a space-based laser that could be used to destroy ballistic missiles, and a concept definition study to design and develop a ground test bed for fire control of a space-based laser. A number of technology contracts support this area, including a development program called passive and active control of space structures (PACOSS) and the rapid retargeting/precision pointing (R2P2) program. PACOSS is investigating the effects of modern composite materials, passive damping techniques, and active control techniques on the behavior of large space structures, while R2P2 uses a ground simulator to evaluate the performance of a space-based laser.

Martin Marietta also has been actively involved in a broad range of successful system integration activities for the past 25 years, including space launch vehicles, strategic missiles, spacecraft for both Earth-orbit and planetary missions, and command and information systems that support space and defense programs. The directing and integrating of large, complex tasks is expected to continue to play a big role in the company's future.

One of the largest system integration jobs the company is handling is the installation and checkout of ground support systems at the West Coast Space Shuttle launch complex at Vandenberg Air Force Base. The effort includes overseeing the design, procurement, installation, and testing of all the facilities and support systems required by the Air Force to launch and recover the Space Shuttle at Vandenberg. Denver Aerospace is integrating contractor for the Shuttle ground support system development at Vandenberg and provides system integration support for the Peacekeeper missile system.

PACOSS

# Denver Aerospace Milestones

| Date | Event |
|---|---|
| Feb 1956 | Construction begins on Denver Aerospace facilities |
| Feb 6, 1959 | First Titan I test launch |
| May 3, 1961 | First Titan I silo launch |
| March 16, 1962 | First Titan II test launch from silo |
| April 8, 1964 | First Titan II/Gemini launch (unmanned) |
| Sept 1, 1964 | First Titan IIIA launch |
| March 23, 1965 | First Titan II/Gemini manned flight |
| June 3-7, 1965 | First American "spacewalk"—Gemini 2 |
| June 18, 1965 | First Titan IIIC launch |
| Nov 15, 1965 | First rendezvous of two spacecraft—Gemini 6 & 7 |
| July 29, 1966 | First Titan IIIB launch |
| Nov 11, 1966 | Twelfth (tenth manned) and final Titan II/Gemini launch |
| April 1969 | First flight of X-24A |
| July 31, 1971 | Lunar drill first used on the Moon—Apollo 15 mission |
| June 15, 1971 | First Titan IIID launch |
| May 14, 1973 | Skylab launch |
| May 25, 1973 | First Skylab crew launch |
| July 28, 1973 | Second Skylab crew launch |
| Aug 1973 | First flight of X-24B |
| Aug 13, 1973 | First use of Manned Maneuvering Unit inside Skylab |
| Nov 16, 1973 | Third Skylab crew launch |
| Feb 11, 1974 | First Titan IIIE launch |
| May 30, 1974 | Largest and most powerful NASA communications satellite to date launched by a Titan IIIC |
| Aug 20, 1975 | Titan IIIE launched Viking I to Mars |
| Sept 9, 1975 | Titan IIIE launched Viking II to Mars |
| July 20, 1976 | Viking I landed on Mars |
| Sept 3, 1976 | Viking II landed on Mars |
| Aug 20, 1977 | Titan IIIE launched Voyager 2 spacecraft |
| Sept 5, 1977 | Titan IIIE launched Voyager 1 spacecraft |
| Sept 22, 1978 | Delivery of first Space Shuttle booster parachute system |
| Jan 30, 1979 | SCATHA research satellite launched |
| March 1979 | Voyager 1 spacecraft rendezvous with Jupiter |
| May 1979 | Space Shuttle checkout, control and monitor subsystem delivered to Vandenberg launch facilities |

| Date | Event |
|---|---|
| June 8, 1979 | New ICBM system (later named Peacekeeper) announced |
| July 1979 | Delivery of first Space Shuttle external tank flight unit |
| July 1979 | Voyager 2 rendezvous with Jupiter |
| Feb 28, 1980 | Delivery of first Titan 34D |
| Nov 1980 | Voyager 1 rendezvous with Saturn |
| Feb 1981 | Delivery of first Manned Maneuvering Unit intended for flight |
| April 12, 1981 | Inaugural flight of Space Shuttle "Columbia" |
| Aug 1981 | Voyager 2 rendezvous with Saturn |
| Sept 1981 | World's first large-scale solar photovoltaic power facility activated in Saudi Arabia |
| Sept 1981 | Dedication of solar central receiver power plant at Almeria, Spain |
| Dec 1981 | First large-scale commercial solar project in U.S. activated at Barstow, Calif. |
| March 6, 1982 | Last Titan IIIC launch |
| May 21, 1982 | Activation of solar photovoltaic power system for Sky Harbor Airport in Phoenix, Arizona |
| June 27, 1982 | Launch of fourth and final test flight of Space Shuttle |
| Oct 22, 1982 | First launch of Titan 34D |
| | First "lightweight" external tank for Space Shuttle delivered |
| May, 1983 | Viking I lander ceases transmission ending phenomenally successful mission |
| June, 1983 | Voyager 1 becomes first man-made object to leave Solar System |
| June 17, 1983 | First Peacekeeper test flight |
| Feb 7, 1984 | First flight of Manned Maneuvering Unit on STS 41-B |
| April 8, 1984 | MMU/Solar Max Repair Mission (STS 41-C) |
| Oct 21, 1984 | First external tank arrives at West Coast Shuttle launch complex |
| Nov 1984 | Palapa/Westar Retrieval Mission (STS 51-A) |
| Aug 23, 1985 | First Peacekeeper test flight from an underground silo |
| Sept 9, 1985 | First demonstration of mobility test vehicle for hard mobile launcher for the small ICBM |

MARTIN MARIETTA

PUBLIC RELATIONS
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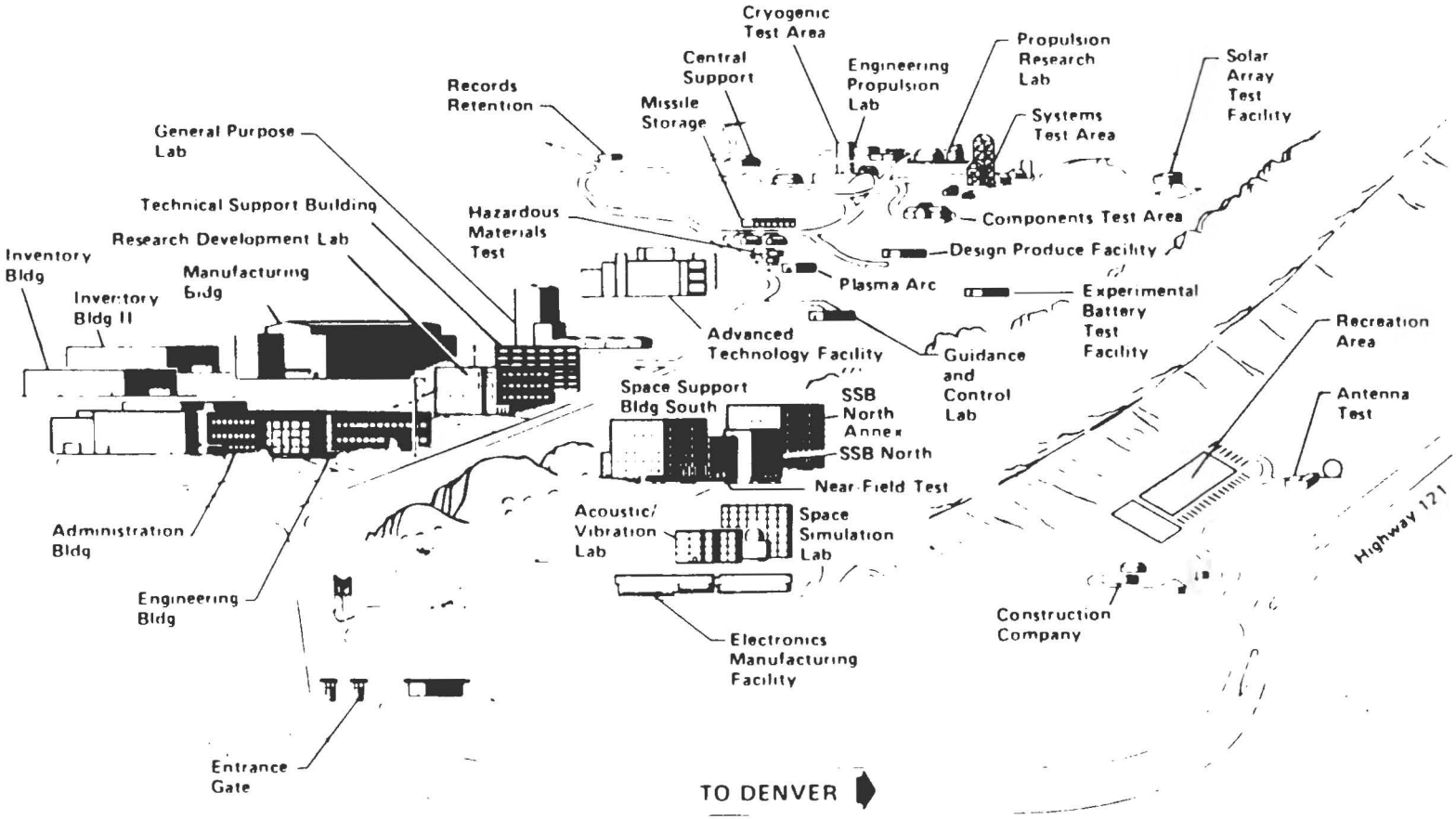
Denver, Colorado 80201
Phone: (303) 977-5364

December 1985

# Martin Marietta Astronautics Group Facilities



## Key Personnel for VIP Event

| | | |
|---|---|---|
| Team Lead | Don Parsons | (Work) 303/977-3627, 3639<br>(Home) 303/986-7559 |
| Public Relations | Art Koski | (Work) 303/977-5364<br>(Home) 303/978-0404 |
| | Dave Whitaker | (Work) 303/977-5364<br>(Home) 303/797-6466 |
| Manufacturing/Facilities | Gene Horak | (Work) 303/977-4094<br>(Home) 303/721-0818 |
| Protocol | Irma Jean Guire | (Work) 303/977-5343<br>(Home) 303/986-6939 |

# Metro Denver

# Martin Marietta Corporation
# 1986 Annual Report

## Contents



## Cover

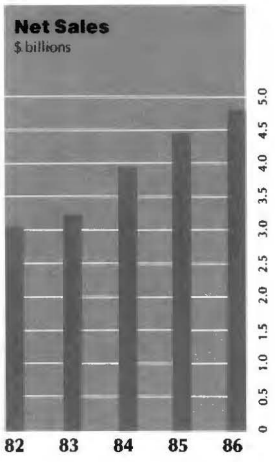
A new laboratory at Martin Marietta Denver Aerospace provides a unique national test facility for ground or space systems requiring highly accurate pointing capabilities, such as space telescopes, space station instruments, and lasers for communications. Built to test rapid retargeting systems for the Strategic Defense Initiative, the laboratory's precision is equivalent to pinpointing an object as small as a football at a distance of 3,000 miles.

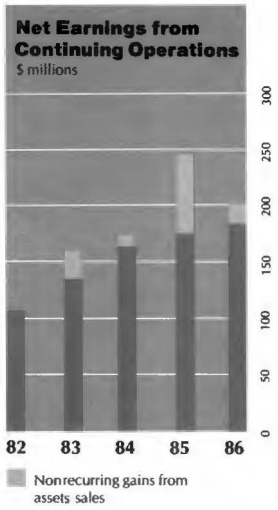
# Martin Marietta Corporation 1986 Annual Report

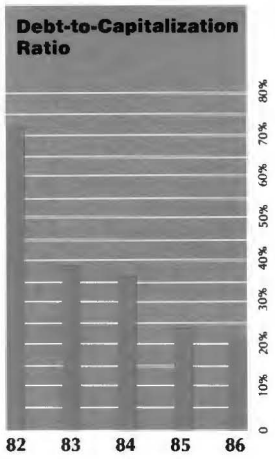
## Financial Highlights

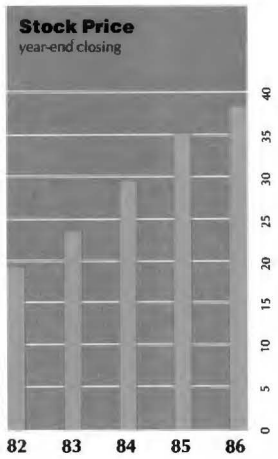
($ in millions, except per share)

| | 1986 | 1985 |
|---|---|---|
| Sales | **$4,752** | $4,410 |
| Net Earnings | **$202** | $249 |
| Earnings Per Share | **$3.67** | $4.36 |
| Cash Dividends per share | **$1.00** | $.97⅓ |
| Debt-to-capitalization ratio | **21%** | 24% |
| Common Shares Outstanding, average | **55,147,793** | 56,619,040 |
| Number of Shareholders | **40,386** | 39,818 |




**Martin Marietta Corporation is an aerospace and information technology company engaged in the design, manufacture, and integration of systems and products in the fields of space, defense, electronics, communications, information management, energy, and materials.**

### Notice of Proxy

A formal notice of the Annual Meeting of shareowners of the Corporation, together with a proxy, will be mailed to each shareowner approximately four weeks prior to the meeting. Proxies will be requested by the Board of Directors at the meeting.

### Form 10-K

The Corporation's Annual Report on Form 10-K, filed with the Securities and Exchange Commission, is available upon written request to the Investor Relations Office, 6801 Rockledge Drive, Bethesda, Maryland 20817.

# To Shareowners

Martin Marietta Corporation improved its performance in 1986 while continuing to enlarge and strengthen the foundation of advanced technologies and new business initiatives we believe necessary to support operating and financial growth over the next decade.

Sales increased to a record $4.75 billion, and net earnings were $3.67 per share, compared with $4.36 the prior year, including nonrecurring gains from the sale of assets of 29 cents in 1986 and $1.29 in 1985.

Shareowners' equity increased 19%, raising book value to $15.35 per share. The ratio of debt to capitalization was 21%, compared with 24% the prior year, and the per-share price of the Corporation's common stock increased 9%. Backlog was maintained near 1985's record level of $8.8 billion, even after major adjustments caused by stretch-outs in the national space effort.

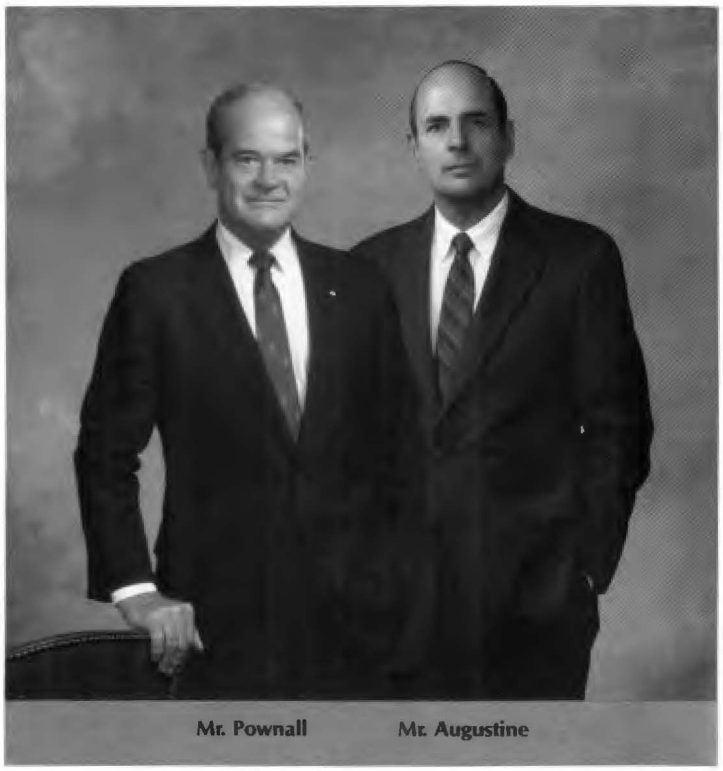
The 1986 results reflect not only continued sales growth but improved margins on programs achieving operational status and higher rates of production.

As a leading contractor to the U. S. Government, the Corporation's primary mission is the application of advanced technologies to the production of aerospace and information systems in support of the nation's defense and space requirements.

It is difficult to recall another time in the Corporation's history when this mission was more emphatically demonstrated than in 1986. Four major defense systems were placed in the hands of operational field elements of the Army, Navy, and Air Force. All reached operational status on schedule and with high customer confidence in their capability, reliability, and maintainability.

It is important to view the year's accomplishments, and the future, in the light of a more demanding market environment, heightened competition, more restrictive national budgets, and changes in the national space effort in the wake of the Space Shuttle accident. Considering all of these factors, we continue firmly in the belief that Martin Marietta has properly positioned itself for the opportunities ahead, including further earnings growth in 1987.

Tighter budget environment, greater competition, and increased numbers of fixed-price contracts have put a



Mr. Pownall Mr. Augustine

premium on our management of costs and risk. Although a fixed-price environment should promote realistic pricing, it sometimes encourages excessively low bidding and the "winner's" prize of a profitless contract. The only thing worse than losing is bidding a contract at a price below the cost of performing the work. We believe our people and facilities are equal to the challenge this climate presents and that effective management of costs and risks can optimize our performance in support of national goals while at the same time meeting the natural expectations of shareholders in a free-enterprise society.

The outlook for 1987 and beyond, for both our aerospace and information systems businesses, is uniformly positive but varied in specifics for each business area. The Martin Marietta aerospace companies at Baltimore, Denver, New Orleans, and Orlando serve the Department of Defense and the National Aeronautics and Space Administration, whose budgets have been flattening. For this reason, aerospace revenues are not expected to grow at recent historic rates. In this circumstance, our strategy is aggressively to seek market

share in those segments of the aerospace market we have identified for the application of selected advanced technologies.

In particular, we have focused on systems which have high electronics content. The Corporation has become, to a significant extent, a defense electronics company, with 40% of all 1986 defense sales derived from that source. Such revenues have more than doubled in the past three years and will continue to climb over the next few years. Our belief is that the growth of defense electronics will outpace the growth rate of the total defense market.

Grounding of the Shuttle fleet and a new emphasis on expendable launch vehicles have resulted in the Air Force increasing orders for the Titan family of launch vehicles. At the same time, in response to a newly enunciated national policy and in view of a substantial backlog of communications satellites requiring transportation into space, the Corporation has offered a commercial version of the Titan. Seven companies had by early 1987 reserved positions for nine satellites to ride on Titans, beginning in 1989.

Martin Marietta continues to have the most diversified contract portfolio of any of the major defense and space contractors. Our 10 largest programs account for about half of total sales, and the largest program is no more than 10% of the total.

The market for information systems is growing rapidly. It is colored by a proliferation of competitors, by a mixture of regulation and deregulation, and by especially rapid technological obsolescence. Opportunity is great for those who choose market segments carefully. Martin Marietta has broad experience in producing large-scale information systems for defense application, where selection of market opportunities is driven primarily by our systems engineering and integration capabilities. We expect that revenues of our two information systems companies, Martin Marietta Data Systems and Martin Marietta Information & Communications Systems, will grow rapidly during the next decade.

Our plan, then, is to maintain respectable aerospace growth through greater market share, together with good profitability. We expect to expand revenues from information systems by selectively exploiting our systems integration strengths and by nurturing our materials business, particularly construction aggregates, which provides a strong cash flow and healthy profits.

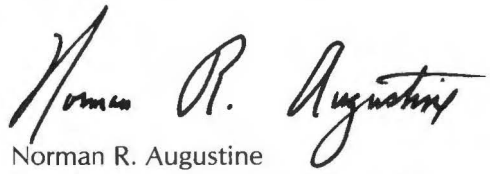
Performance to this plan in 1986 produced increases in both aerospace sales and earnings. Information systems sales increased 18%, while earnings were essentially flat due to expenditures for new business and losses in a commercial software business divested before year-end. The Aggregates company increased both sales and earnings by approximately 19%, and the Magnesia Specialties company had improved margins on slightly lower sales in a relatively depressed marketplace. Operational reviews and financial breakouts of these businesses can be found on the following pages of this Annual Report.

The Corporation is fortunate to have obtained the services in 1986 of a distinguished educator, Dr. John B. Slaughter, Chancellor of The University of Maryland, who was elected to the Board of Directors in December.

With the ongoing counsel of a dedicated Board of Directors and the continued support of our stockholders, we believe Martin Marietta is in excellent position to maintain the enthusiasm of its multi-talented and highly motivated body of employees to grow and prosper.

Respectfully,

Thomas G. Pownall
Chairman and Chief Executive Officer



Norman R. Augustine
President and Chief Operating Officer

February 7, 1987

# Operations Review


**Human factors specialist Robert Overmyer, a former astronaut, adjusts a common module on a scale model of the Space Station at NASA's Marshall Space Flight Center, where Martin Marietta has built a full-scale simulator of the module (behind him).**

# Space and Strategic Systems

**Martin Marietta Denver Aerospace**
**Martin Marietta Michoud Aerospace**

The year 1986 was one of solid achievement for Martin Marietta as a contractor on some of the nation's primary space and strategic programs, including the NASA Space Station, the Air Force's newly deployed Peacekeeper and its developmental Small ICBM, the Strategic Defense Initiative, and the Magellan spacecraft which will radar-map the "mystery planet" Venus. Major new contracts were received for Titan space launch vehicles, and the Corporation entered the commercial marketplace by offering a version of the Titan to launch communications and other satellites.

### Space Shuttle

The loss of the Challenger, after 24 historically successful Space Shuttle flights over a four-year period, affected the entire national space effort, including production of the External Tank at Martin Marietta Michoud Aerospace. Production continued at a diminished rate. Seven tanks were completed during the year. In anticipation of resuming Shuttle missions in 1988, the space agency directed Martin Marietta to prepare for production of 60 more of these huge tanks which fuel the Shuttle's main engines and serve as the chassis for the Orbiter and solid rockets during launch.

### Launch Vehicles

In the area of expendable launch vehicles, the Corporation moved simultaneously along several tracks. Martin Marietta Denver Aerospace received an Air Force authorization bringing to 23 the number of Titan IV vehicles ordered. And work began on a contract to convert deactivated Titan II ICBMs to space boosters for smaller payloads. Contract options provide for additional conversions.

Entering a new segment of the space launch market, Martin Marietta offered a commercial version of the highly reliable Air Force Titan. By early 1987, initial reservations had been made to launch nine communications satellites on Titans starting in 1989. This is a highly competitive and demanding market, but it holds substantial promise in the years ahead for a space launch vehicle of Titan's lift capability.

### Space Station

As a leading contractor in the U.S. Space Station program, Martin Marietta completed definition and preliminary designs this year in a competition to develop the station's primary components, the modules that will become orbital living spaces, laboratories, and logistics compartments. In addition, the Corporation built and installed at the NASA Marshall Space Flight Center in Alabama a full-scale, functioning model of a 43-foot-long station module. It is being used for simulation and testing of systems for the Space Station program, in which final design and development contracts are expected to be awarded in 1987.

The Space Station will open the next era in the exploration and exploitation of space. NASA plans to have a permanent, manned station in orbit by 1994 as an evolutionary center for scientific and commercial ventures as well as a launch pad for future missions to the moon, Mars, and elsewhere in the ocean of space.

Under a related contract, engineers at Denver undertook a study of the most effective methods for handling propellants and other fluids aboard an orbiting station. Propellant management will be one of the keys to the station's successful operation.

### Transfer Orbit Stage

In August, Denver Aerospace rolled out the first Transfer Orbit Stage, an upper stage vehicle to boost spacecraft into higher orbits after launch from the Space Shuttle. Privately funded by the Orbital Sciences Corporation, of Fairfax, Virginia, the TOS has been selected as the upper stage for two planned NASA missions, the Mars Observer spacecraft and the Advanced Communications Technology Satellite. The TOS, which also is planned to be compatible with the Titan booster, is under consideration for other NASA missions.

### Peacekeeper

The Air Force Peacekeeper ICBM reached operational deployment on schedule after an uninterrupted string of 15 successful flight tests over the Pacific Missile Range. The program has been described as the "most successful" ICBM test series ever conducted. Martin Marietta is the assembly, test, and systems support contractor for the Peacekeeper.

As advanced testing continued, initial deployment took place on schedule at Warren Air Force Base, Wyoming, where massive emplacement vehicles, also developed and produced by Martin Marietta, were used to position the missiles in underground silos. A team at Denver Aerospace is studying alternative basing concepts for Peacekeepers under another Air Force contract.

### Small ICBM

Martin Marietta has a similar role as the Air Force's primary contractor for assembly, test, and systems support in another strategic program, development of a small intercontinental ballistic missile for mobile deploy-

ment in the early 1990s. Preliminary designs were completed and Denver Aerospace began development of both the post-boost vehicle that comprises the upper stage and the support hardware for planned flight tests starting in 1989.

### Strategic Defense Initiative

Martin Marietta is a major participant in the Strategic Defense Initiative. As such, the company completed a preliminary study of alternative system architectures in early 1986 and carried forward projects in laser applications, kinetic and directed energy devices, control of space structures, optical sensors, high-altitude seeker concepts, and fine-pointing technology. A unique rapid retargeting laboratory, anchored on North America's most stable rock formation, went into operation at Denver Aerospace as a principal simulation facility for SDI pointing and targeting technology. The Corporation also heads one of two industry teams competing for selection to develop a national test bed to simulate, demonstrate, and evaluate elements of a strategic defense system.

### Spacecraft

Looking toward future space exploration, development moved ahead at Denver on the Magellan spacecraft, which will use new synthetic aperture radar to pierce permanent clouds and map the surface of the planet Venus following launch in 1989.

Sophisticated instruments delivered in earlier years will fly on three other upcoming missions—an ultra-long-range Faint Object Spectrograph that will be the long-distance eyes of the Hubble Space Telescope; an instrument package that will descend to Jupiter from the Galileo spacecraft;

**An emplacer positions one of the first 10 Air Force Peacekeeper missiles to become operational in 1986 at Warren Air Force Base, Wyoming. Martin Marietta is the assembly, test, and systems support contractor for the missile, as well as manufacturer of the emplacers.**

and a 62-mile-long tethered system which, when deployed from the Space Shuttle, will troll a research satellite through the upper reaches of the Earth's atmosphere.

Scientific instruments being built for both an orbiting astrophysical observatory and the projected Mars mission will further expand Martin Marietta's role in NASA planetary space studies.

Michoud Aerospace also received a contract in May to assess the feasibility of utilizing a Space Shuttle external fuel tank during a future launch as an orbiting research satellite after its fuel is expended.

### Artificial Intelligence

Emerging artificial intelligence technologies are central to a great deal of today's developmental work, with present or potential applications in defense, space, information management, manufacturing, and other fields. Projects underway at various Martin Marietta locations in 1986 encompassed such areas as automatic target recognition, so-called "brilliant" or "fire-and-forget" missiles, advanced navigation, expert systems for Space Station operations, and autonomous spacecraft for future missions.

Centerpiece of the Corporation's artificial intelligence work is a national test bed under development at Denver for advanced computer architectures, experimental software, and a variety of sensory technologies including television, lasers, and radar. Funded by the Defense Advanced Research Projects Agency, the test bed experiments and instruments are housed in an unmanned land-roving vehicle which operates autonomously. In 1986, this program passed a number of developmental milestones, including successful negotiation of a 2.5-mile curved test track at speeds up to six miles an hour; obstacle avoidance; and straight-course speed of 12.4 miles an hour.

By the early 1990s, under current planning, the evolutionary vehicle is expected to be capable of operating in excess of 30 miles an hour on or off the road, plotting a course to a given destination using an on-board computer map, making course changes without human intervention, and electronically "reporting back" from a remote location.

# Defense Electronics and Tactical Systems

**Martin Marietta Orlando Aerospace**

Martin Marietta is a major developer and manufacturer of high-technology tactical systems, including air defense and airborne navigation and targeting systems for the armed forces.

A number of these programs reached production or proceeded through various stages of research and development during 1986, and two of the systems became operational.

### TADS/PNVS

Martin Marietta Orlando Aerospace completed the third full year of production of the TADS/PNVS electro-optical navigation and targeting system for the Army's AH-64 Apache attack helicopter. The initial operating units equipped with this all-weather, night-and-day system were activated at Fort Hood, Texas.

A follow-on production contract brought Army orders to 582 units, of which 230 had been produced by year-end. Deliveries are planned through 1992, based on an expected total requirement of approximately 600 units.

### Hellfire

One of the primary armaments of the Army's Apache helicopter is Hellfire, a laser-guided weapon system also in production at Orlando. More than 1,100 of the anti-armor missiles have been delivered, and a contract awarded in 1986 brought the total on order to more than 9,000. Martin Marietta developed and produces the laser guidance for Hellfire and is a co-producer of the missile. Total procurement from both producers is expected to reach 65,000 missiles.

### LANTIRN

LANTIRN, an Air Force system that utilizes electro-optics, radar, and computer technologies to "turn night into

**The TADS/PNVS, a nose-mounted targeting and night vision system (top) developed by Martin Marietta, became operational on schedule in 1986 with the Army's first unit of Apache attack helicopters at Fort Hood, Texas.**

**Charles Roux (left) and Gary Butler prepare a LANTIRN electro-optical navigation pod for final testing at Orlando before its delivery to the Air Force.**

day" for pilots of high-performance F-15E and F-16 tactical strike aircraft, moved toward full production after more than 1,100 hours of operational testing, including substantial low-altitude flight over varied terrain.

A production award brought the number of navigation pods on order to 152, the first of them to be delivered in April of 1987, and the system's targeting pod entered initial production in anticipation of a high-rate follow-on order.

The Air Force currently plans to order 700 of the two-pod systems, which double a tactical strike aircraft's year-round operational capability and substantially increase aircraft effectiveness in many tactical environments. A LANTIRN-derived system also is under consideration for the B-1B strategic bomber.

### Targeting Systems

For the Navy, production continued on a laser fire-control system for carrier-based F-18 attack aircraft. The all-weather LST/SCAM system employs a laser-detector and on-board computer to locate, track, and lock on designated ground targets with pinpoint accuracy, simultaneously providing a strike assessment by photographs before, during, and after impact. Seventy-five units have been delivered of 181 on order through 1988.

In another program that grew out of these proven airborne systems, Orlando Aerospace now is developing, under a competitive contract awarded in August, a sophisticated targeting system for ground combat vehicles. Mounted on a 50-foot retractable mast, the Army's Elevated Target Acquisition System will combine high-resolution television, an infrared sensor, radar, and a laser beam in an electronic package enabling targets at extended range to be located, tracked, and designated for ground or air strike at night and in low visibility.

**Ernest Buckly (left) and Michael Neener perform engineering tests on a Mach 2.5, low-altitude target drone under development for Navy missile defense training and evaluation.**

### Copperhead

Production continued with a new contract awarded at mid-year for Copperhead, the highly accurate laser-guided artillery shell. Orders from the Army and Marine Corps total more than 23,000 of 40,000 planned through 1992. Close to 14,000 rounds have been produced to date at the Orlando plant, with 3,600 of them delivered in 1986. In periodic production-lot acceptance tests at White Sands Missile Range, New Mexico, more than 85% of Copperhead firings during the year were on target, exceeding the Army's objective of 80%.

### Patriot

Production continued at Orlando on Patriot, a new-generation, multi-target Army anti-aircraft missile now deployed with operating forces. In a further development of this highly successful program, a Patriot was used to intercept an incoming Army Lance missile in a September test of defensive capability against tactical missile attack. The Corporation has received a development contract to modify some components of the system for this potential role. At year-end, negotiations began for an additional subcontract from Raytheon Corporation to extend Patriot production well into the next decade.

### Air Defense

Further broadening the Corporation's role in the air defense field, an international team, headed by Oerlikon Buehrle of Switzerland and including Martin Marietta, was selected early in 1986 by Canada's Ministry of Defense to build a Low-Level Air Defense System called LLADS. Martin Marietta is building the electro-optical tracking and guidance modules for the system, which includes dual 35-millimeter guns as well as the 8-missile ADATS Air Defense Anti-Tank System previously developed by Orlando Aerospace for Oerlikon Buehrle.

### Multiple Launch Rocket System

Another international effort teams Martin Marietta and firms from Great Britain, France, and West Germany in the development of terminally guided warheads containing submunitions for NATO's mobile, rapid-fire Multiple Launch Rocket System. The goal is optimum all-weather accuracy against tanks, self-propelled vehicles, and mobile surface-to-surface systems. Mar-

tin Marietta completed a test version of an advanced millimeter-wave-radar seeker for the warheads and demonstrated its ability to recognize targets against a variety of backgrounds. A prototype is scheduled for testing before the end of 1987.

**Supersonic Target Vehicle**
Development of a supersonic low-altitude target vehicle for Navy missile defense training proceeded toward initial test flights in 1987. The air-launched supersonic drone, known as SLAT, would be capable of flying 30 feet above the water at Mach 2.5 for a considerable distance. It is designed to evaluate defense systems and train personnel to defend ships against high-speed, sea-skimming missiles. The drone is powered by an advanced rocket-ramjet proven in an earlier Air Force program.

**Deadeye**
Development moved forward on a laser-guided projectile called Deadeye for use by Navy shipboard 5-inch guns in support of amphibious operations and against moving and stationary targets ashore. Orlando Aerospace is currently improving the microprocessor for the shell's guidance and control system and is defining a 15-round qualification field test program to start in 1988.

**Pershing II**
In the Army's Pershing II intermediate-range missile program, the third generation of this tactical system deployed with NATO forces in Germany is scheduled to remain in production through 1987. Army troops test-launched eight Pershing IIs in 1986 exercises at White Sands Missile Range and Cape Canaveral.

# Aero-Mechanical Systems

**Martin Marietta Baltimore Aerospace**

The Corporation produces for the armed services as well as commercial customers a range of aero-mechanical systems employing sophisticated manufacturing techniques and advanced materials.

**Vertical Launching System**
The Navy's new Vertical Launching System, developed and manufactured by Martin Marietta Baltimore Aerospace, achieved operational status with the commissioning in September of the cruiser U.S.S. Bunker Hill. It is the first vessel to receive the versatile, rapid-firing system for launch of air-defense, surface-to-surface, and anti-submarine missiles. Vertical launching systems also have been delivered for four other cruisers, the Mobile Bay, Antietam, Leyte Gulf, and Lake Champlain, and for the first destroyer to be outfitted, the U.S.S. Spruance.

Baltimore Aerospace is under contract to produce launching systems for a total of 25 U.S. cruisers and destroyers plus four Canadian Maritime Command destroyers now being modernized. As highly successful firings demonstrated during sea trials, the new launchers, coupled with advanced radar and weapons control, mark a major step forward in firepower for the surface fleet.

**Navy Combat System**
In yet another Navy program, Martin Marietta is teamed with two other companies in a competition to develop the combat system for a new attack submarine. Baltimore would provide the system's wide-aperture array sonar sensor. Under a contract received from the Woods Hole Oceanographic Institute, a low-frequency acoustic transmitter is being developed for real-time mapping of deep ocean

**Laser light illuminates a 500-meter spool of optical fiber, which Baltimore Aerospace engineer Russell May aligns in an experiment to develop secure communications.**

# Aero-Mechanical Systems

currents, water density, temperature, and other characteristics that affect phenomena ranging from weather to sonar and underwater communications.

### Robotics

In the field of robotics, Martin Marietta undertook an Army contract in early 1986 to develop an experimental robot to handle bulk ammunition and palletized cargo. With a 25-foot-long manipulator arm and a load capacity of 4,000 pounds, the robot will be designed to handle three times as much ammunition every hour as four men can move using forklifts. In addition to relieving manpower, it would reduce personnel risk. A major new robotics laboratory, scheduled for completion in early 1987 at Baltimore Aerospace, will be used to test the system and conduct future programs.

### B-1B Bomber Components

Production also continued at Baltimore on two multi-year manufacturing programs. Martin Marietta delivered, under subcontract to Rockwell International, 39 shipsets of horizontal stabilizers, 43 vertical stabilizers, and 47 shipsets of flight control vanes for the Air Force's B-1B strategic bomber.

### Thrust Reversers

For General Electric military and commercial jet engines, Baltimore produced 106 thrust reversers that provide braking action during landings. More than half were a new, lightweight version that makes more extensive use of composite materials. Over the past 15 years, more than 2,000 thrust-reverser assemblies have been produced, and new orders were received for both models.

**A missile and launch canister are lowered into the cell of a new, rapid-fire Vertical Launching System, which can handle a variety of Navy missiles. It became operational on schedule aboard the U.S.S. Bunker Hill, the first Navy warship to go to sea so equipped. Baltimore Aerospace is producing the systems for 25 U.S. and four Canadian naval vessels.**

# Information Systems

**Martin Marietta Data Systems**
**Martin Marietta Information & Communications Systems**

In the fast-growing information systems area, Martin Marietta provides services to government and industry in fields that include command and control, information management, telecommunications, data processing, and systems integration.

Two operating companies, Martin Marietta Data Systems and Martin Marietta Information & Communications Systems, participate in these varied markets for the integrated application of advanced computer and communications technologies.

Martin Marietta Data Systems is a leader in design, installation, and management of multi-function computer systems to serve the operating requirements of large organizations. The company was working under more than 100 information processing and management contracts at year-end 1986, many of them with the government, in areas as varied as personnel administration for the Navy and crop reporting for the Agriculture Department.

### Systems Integration

One substantial contract, supporting the Defense Department's worldwide medical benefits program for 10 million dependents and retirees, was renewed for a third 3-year term after a competitive selection. On another, for the Navy, funding was increased for a data management system that meets diverse requirements at naval stations and aboard aircraft carriers in the areas of training, maintenance, and in-flight performance.

The U.S. Military Academy contracted for further enhancements of an instructional system linking classrooms, laboratories, offices, and study facilities designed and initially installed by Martin Marietta in 1982. The 1,000-terminal West Point system is one of the most sophisticated and extensive in the country.

In Orange County, California, a follow-on contract broadened the company's responsibilities in management and operation of a data center which processes tax assessments, payroll, health and welfare benefits, and other material for the Los Angeles metropolitan county's two million residents.

### Applications Software

To further concentrate the Data Systems company's resources on its successful systems integration and management business, Data Systems divested its packaged software business in 1986.

The company retains its line of custom applications software, further improved during 1986. These customized modular systems have direct application to the integration of complex information systems in the commercial sector and are particularly suitable for manufacturing and distribution industries.

### International Operations

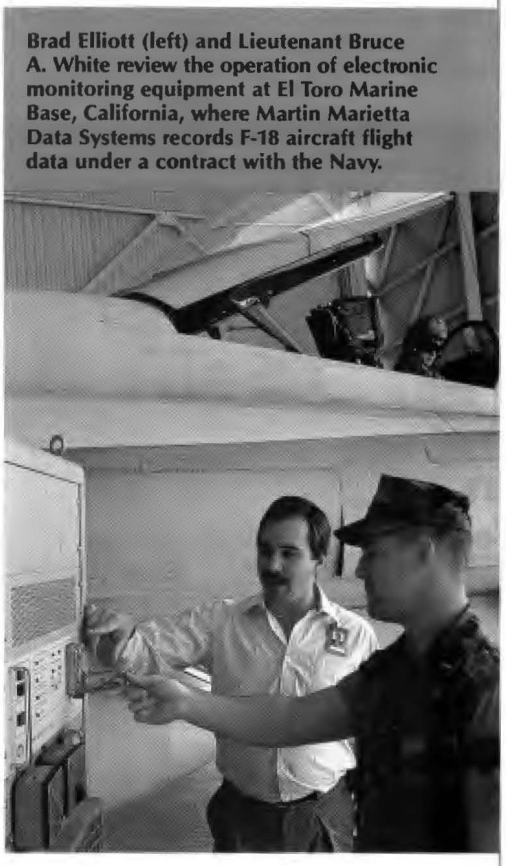
The Data Systems company's international subsidiary, Hoskyns Group Limited, strengthened its position as one of the leading computer services companies in the United Kingdom. The London-based operation derives a large percentage of its revenue from the manufacturing marketplace.

At year-end, Martin Marietta took the Hoskyns subsidiary public on the London Stock Exchange, selling a 25% minority interest. The action enhances Hoskyns' competitive position as a U.K. company by increasing its ability to acquire complementary businesses abroad. Over the past 10 years, Hoskyns has achieved an average annual growth rate of more than 30%.

### Mobile Military Communications

Martin Marietta Information & Communications Systems designs, builds, and integrates advanced information systems utilizing state-of-the-art technologies in electronics, communications, signal processing, and data processing.

In 1986, the company made first deliveries to the Air Force of a mobile, computerized, communications control center that provides improvements in speed, flexibility, and reliability for air and ground networks. Replacing manually operated equipment, the new digital system automatically monitors and controls voice and high-speed data circuits, detects equipment degradation or



**Brad Elliott (left) and Lieutenant Bruce A. White review the operation of electronic monitoring equipment at El Toro Marine Base, California, where Martin Marietta Data Systems records F-18 aircraft flight data under a contract with the Navy.**

Air Force Staff Sgt. Anthony Proffer tests a Martin Marietta-developed tactical communications system. The automated, mobile control unit, which became operational on schedule during 1986, monitors and routes air and ground communications.

breakdown, and reroutes traffic as necessary to maintain optimum performance.

By year-end, the company had produced 15 of these Communications Nodal Control Elements of 72 currently on order by the Air Force for deployment with tactical units in the United States and overseas.

### Air Traffic Control

Significant progress was achieved in the Federal Aviation Administration's long-term modernization of the nation's air traffic control, navigation, and communications network.

Nearly 100 major contractors are providing the hardware for the 92 separate projects performed on this program, for which Martin Marietta is systems engineering and integration contractor. The first of a new generation of air traffic computers, scheduled for 20 FAA control centers, was installed at the Seattle center and is scheduled to begin operation in 1987.

Other milestones included installation of wind-shear alert systems at 85 airports, increased automation of flight information, and replacement of selected navigation and communications equipment. Production, delivery, and integration of sophisticated new hardware to upgrade the airways will continue well into the 1990s.

### Strategic Defense Architecture

An 8-company team headed by Martin Marietta twice during 1986 received contracts in the initial two phases of competition to develop a national test bed for command, control, and communication architectures of the Strategic Defense Initiative. Following

submission of preliminary designs for the simulation and evaluation facility, to be located in Colorado, award of a development contract is scheduled for 1987.

### Tactical Control Center

Under another of several contracts in the military command, control, and communications area, the first engineering test unit of a transportable information management system for the Army and Air Force was turned over to the services for field testing at Fort Hood, Texas. The Information & Communications Systems company is integrating contractor for this computer-based system, which will enable tactical commanders to analyze and correlate intelligence data from a variety of sources and sensors.

### FTS 2000 Telecommunications

In mid-1986, the Corporation formed a team to compete for and operate the new federal telecommunications system known as FTS 2000. Teamed with Martin Marietta's Information & Communications Systems company, the prime contractor, are Northern Telecom Inc. to provide network design and technical support, MCI Communications Corporation as the long-distance carrier, and seven regional Bell operating companies.

The team is preparing its response to the General Services Administration's request for proposal, issued early in 1987 in expectation of a contract award late in the year. The digital network will provide voice, data, video, and other services for government agencies throughout the country and will represent the next generation of technology for the world's largest dedicated telecommunications system.

# Materials

**Martin Marietta Aggregates**
**Martin Marietta Magnesia Specialties**

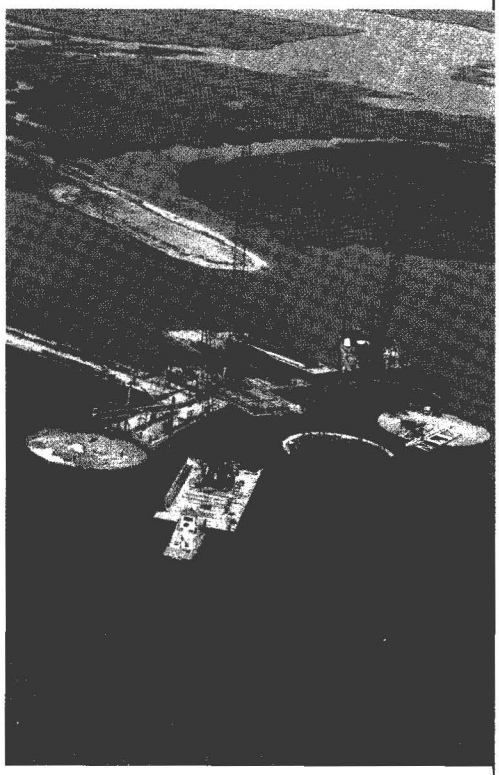
Martin Marietta Aggregates, one of the nation's leading producers of crushed stone, sand, and gravel, had another excellent year as a result of strong demand principally in the highway and housing segments of the construction industry. Shipments from the company's 175 operations rose 18%, producing increases in both sales and earnings.

Overall, the construction aggregates business anticipates robust future demand as the need for renewal of roads, bridges, and other elements of the nation's aging infrastructure continues to receive federal and local attention and investment in many parts of the country. To meet these requirements most effectively, Martin Marietta Aggregates has for the past several years placed heavy emphasis on increasing capacity, reducing costs, and seeking new, strategically located reserves and plant sites.

### Growth in Aggregates Markets

Early in 1986, Martin Marietta expanded its business in the midwestern U.S. with the acquisition of Weaver Construction Company of Iowa, the largest aggregates operation in the state, with growing markets, well located quarries, and substantial long-term reserves of raw materials. The addition significantly improves Martin Marietta's position in that part of the country.

Expansion and improvement programs were undertaken this year at plants in high-growth areas of North Carolina, South Carolina, and Georgia to supply highway and commercial construction customers as well as the ongoing needs of a U.S. Navy submarine base under construction in the Brunswick, Georgia, area. Distribution facilities were added or expanded at locations including Frankfurt, Kentucky, and Myrtle Beach, South Carolina.



### Magnesia Specialties

Profitability increased for Martin Marietta Magnesia Specialties, a primary supplier of refractory materials used in steelmaking and of specialty products used in fuel treatment, chemical processing, ceramics, electrical heating elements, agriculture, rubber manufacturing, and many other applications.

Faced with the continuing consolidation of the U.S. steel industry, still its principal market, the company stepped up new product development aimed at increased diversification, completed an extensive restructuring to reduce costs, and increased market share in established lines supplying higher-technology steel operations. Improved efficiency raised profit margins in all major product lines despite market conditions.

# Energy Systems

**Oak Ridge, Tennessee**
**Paducah, Kentucky**
**Piketon, Ohio**

Martin Marietta Energy Systems completed its second full year as operating contractor for the Department of Energy's research and development, production, and engineering complex at Oak Ridge and Paducah and late in 1986 significantly broadened these responsibilities with an additional contract to operate the Energy Department's large Portsmouth uranium enrichment plant, located at Piketon, Ohio. With approval of the Energy Department, Martin Marietta Energy Systems assumed the contract of the former operator, Goodyear Atomic Corporation.

### Uranium Enrichment

The two government-owned uranium enrichment facilities in Kentucky and Ohio, now both managed by Martin Marietta, supply nuclear fuel to electric utilities in the United States, the Far East, and Europe under multi-year contractual arrangements. In addition to operating the plants, Energy Systems assists in marketing the product to customers. An Oak Ridge research team also is working with engineers at Lawrence Livermore National Laboratory in California to develop a low-cost, laser-based process as the next generation of enrichment technology in this highly competitive international market.

### Fusion Energy Research

Oak Ridge National Laboratory proceeded to important new stages in the study of nuclear fusion, which some day could generate virtually limitless power from abundant hydrogen fuel. Full-scale operational testing began on massive superconducting magnets, potentially key components of future fusion plants. The tests involve magnets of varying designs from the United States, Japan, Switzerland, and West Germany (for Euratom) to provide comparative performance data. At the same time, construction neared completion on the largest experimental fusion facility of its kind, a 22-foot-diameter, doughnut-shaped "stellarator" where further investigations of high-temperature hydrogen plasma will commence in 1987.

Oak Ridge's Y-12 plant, which manufactures nuclear components for the armed forces, maintained on-schedule precision production in 1986 while establishing a National Safety Council record of more than 14 million metal-working employee hours without a lost-time injury. The Y-12 operation also received an award for "innovative, leading-edge" computer-integrated manufacturing from the Society of Manufacturing Engineers.

# Martin Marietta Laboratories

**Baltimore, Maryland**

Martin Marietta Laboratories, the Corporation's research and development center, supports advanced technical programs in the operating companies, conducts research in emerging technologies, and performs contract work for government agencies and private industry.

Laboratories scientists focused in 1986 on a range of disciplines essential to defense, space, and information systems developments.

### Gallium Arsenide Circuits

In the highly promising field of gallium arsenide-based microelectronics, the Laboratories developed the first realistic model for high-frequency, field-effect transistors, and played a prime role in establishment of Gamma Monolithics, a joint venture with Alpha Industries to develop reliable, producible integrated circuits for multiple applications. Microchips of this new material, suitable for applications ranging from millimeter-wave radar and guidance systems to communications, provide devices that are smaller, more reliable, and significantly less costly than conventional counterparts.

### Advanced Composite Materials

A new class of proprietary metal-matrix composite materials developed by the Laboratories was further advanced under a contract from the Naval Research Laboratory and the Defense Advanced Research Projects Agency. The versatile new materials are made by combining ceramics with aluminum, titanium, iron, copper, or other metals. They can be tailored to provide optimum strength and weight characteristics dependent on the end-product use.

Other materials work included development of a flexible ceramic, which could have significant potential for structural applications, and investigation of a ceramic coating to protect aerospace systems against thermal, impact, or blast effects.

Now nearing completion, a major expansion of Martin Marietta Laboratories will nearly double the work area, in particular for electronics and materials investigations.

Scientist Frank Heubaum casts an XD™ advanced metal-ceramic alloy developed by Martin Marietta Laboratories. The proprietary material offers improved strength and weight and can be tailored to specific performance goals.

# Other Operations

Other corporate operations include Martin Marietta Ordnance Systems, Martin Marietta Environmental Systems, and industrial and office parks in Florida, Maryland, and Tennessee.

**Martin Marietta Ordnance Systems** is the operating contractor for the Milan, Tennessee, Army Ammunition Plant, which loads, assembles, and packs a wide variety of ordnance items for the U.S. military and for U.S. Government-approved foreign customers.

**Martin Marietta Environmental Systems,** in Columbia, Maryland, serves as an environmental consultant to Martin Marietta and to outside clients, including the federal government, various state governments, and industry.

**Orlando Central Park, Inc.,** the Corporation's 4,300-acre office, industrial, and commercial park in central Florida, completed and opened two major projects in 1986—the Mercado Festival Center food and shopping mall, with 60 shops and three restaurants, and the 27-story, 891-room luxury Peabody Hotel. A joint venture with Belz Enterprises, the hotel is located across the street from the Orange County Convention and Civic Center.

**Chesapeake Park, Inc.,** owns and operates a 200-acre industrial park near Baltimore and in 1986 began work on Commerce Park, a 300-acre industrial park development at Oak Ridge, Tennessee.
In a related project, the Corporation established the Tennessee Innovation Center, Inc., which invests seed capital in promising new technology ventures at Oak Ridge.

# Statement of Operations

for years ended December 31

(add 000, except per share)

| | 1986 | 1985 | 1984 |
|---|---|---|---|
| Net sales | **$4,752,537** | $4,410,064 | $3,920,400 |
| Cost of sales, other costs, and expenses | **4,421,794** | 4,116,358 | 3,634,082 |
| **Earnings from Operations** | **330,743** | 293,706 | 286,318 |
| Other income and expenses | **17,882** | 160,290 | 54,833 |
| | **348,625** | 453,996 | 341,151 |
| Interest expense on debt | **21,181** | 35,704 | 32,237 |
| Earnings before taxes on income | **327,444** | 418,292 | 308,914 |
| Taxes on income | **125,100** | 168,900 | 132,900 |
| **Earnings from Continuing Operations** | **202,344** | 249,392 | 176,014 |
| **Discontinued Operation:** | | | |
| Operating losses, net of income taxes | **—** | — | (2,778) |
| Estimated losses from disposal, net of income taxes | **—** | — | (365,000) |
| **Losses from Discontinued Operation** | **—** | — | (367,778) |
| **Net Earnings (Losses)** | **$ 202,344** | $ 249,392 | $ (191,764) |
| **Net Earnings (Losses) Per Common Share** | | | |
| Assuming no dilution: | | | |
| Continuing Operations | **$3.67** | $4.36 | $ 3.15 |
| Discontinued Operation | **—** | — | (7.03) |
| | **$3.67** | $4.36 | $(3.88) |
| Assuming full dilution: | | | |
| Continuing Operations | **$3.67** | $4.36 | $ 3.02 |
| Discontinued Operation | **—** | — | * |
| | **$3.67** | $4.36 | * |

*Anti-dilutive

*The notes on pages 21 to 31 are integral parts of these statements.*

**Martin Marietta Corporation** and Consolidated Subsidiaries

**Titan production at Denver includes Titan III space launch vehicles (foreground) and deactivated Air Force Titan II ICBMs being converted to boosters for future space missions.**

# Balance Sheet

at December 31

## Assets

(add 000)

| | 1986 | 1985 |
|---|---|---|
| **Current Assets:** | | |
| Cash and short-term investments | **$ 194,995** | $ 138,165 |
| Notes and accounts receivable | **421,602** | 459,810 |
| Inventories | **363,993** | 317,694 |
| Other current assets | **24,786** | 38,801 |
| Net assets of discontinued operation | **—** | 14,499 |
| Total Current Assets | **1,005,376** | 968,969 |
| **Investments** | **240,217** | 246,515 |
| **Other Noncurrent Assets** | **157,177** | 70,391 |
| **Property, Plant, and Equipment:** | | |
| Land | **80,500** | 71,978 |
| Mineral deposits | **28,707** | 25,419 |
| Buildings | **475,208** | 397,235 |
| Machinery and equipment | **1,408,338** | 1,240,649 |
| | **1,992,753** | 1,735,281 |
| Less allowances for depreciation, depletion, and amortization | **933,682** | 785,945 |
| | **1,059,071** | 949,336 |
| **Costs of Investments in Excess of Net Assets of Acquired Businesses** | **8,904** | 22,858 |
| | **$2,470,745** | $2,258,069 |

## Liabilities and Shareowners' Equity

| | 1986 | 1985 |
|---|---|---|
| **Current Liabilities:** | | |
| Accounts payable and accrued expenses | **$ 383,696** | $ 329,759 |
| Salaries, benefits, and payroll taxes | **216,214** | 237,997 |
| Income taxes | **226,728** | 176,730 |
| Current maturities of long-term debt | **3,003** | 26,541 |
| Total Current Liabilities | **829,641** | 771,027 |
| **Long-term Debt** | **227,700** | 220,413 |
| **Other Noncurrent Liabilities** | **116,998** | 93,175 |
| **Noncurrent Deferred Income Taxes** | **453,030** | 465,497 |
| **Shareowners' Equity:** | | |
| Common stock, par value $1 a share, authorized 250,000,000 shares | **109,404** | 109,404 |
| Additional paid-in capital | **690,845** | 687,381 |
| Retained earnings | **1,184,173** | 1,036,993 |
| | **1,984,422** | 1,833,778 |
| Less treasury common stock at cost, 54,459,849 and 54,232,951 shares | **1,141,046** | 1,125,821 |
| | **843,376** | 707,957 |
| | **$2,470,745** | $2,258,069 |

# Statement of Cash Flows

for years ended December 31

(add 000)

| | 1986 | 1985 | 1984 |
|---|---|---|---|
| **Net Cash Flow from Continuing Operating Activities:** | | | |
| Earnings from continuing operations | **$202,344** | $249,392 | $ 176,014 |
| Noncash items included in earnings: | | | |
| Depreciation, depletion, and amortization | **152,990** | 132,039 | 113,634 |
| Deferred income taxes | **64,300** | 82,340 | 25,150 |
| Net change in receivables, inventories, and payables | **(100,433)** | (203,847) | 194 |
| Other items | **40,493** | 9,855 | 2,753 |
| **Net Cash Flow from Continuing Operating Activities** | **359,694** | 269,779 | 317,745 |
| **Cash Flows from Investing Activities:** | | | |
| Additions to properties | **(273,356)** | (316,063) | (205,457) |
| Retirement of properties, net of sold operations | **8,131** | 9,159 | 12,301 |
| Net (addition) reduction of investments | **(12,238)** | (105,808) | 74,783 |
| Decrease (increase) in other current assets relating to amount due from sale of joint venture interest | **—** | 60,000 | (60,000) |
| Other | **(11,206)** | 15,847 | 28,010 |
| **Net Cash Used for Investing Activities** | **(288,669)** | (336,865) | (150,363) |
| **Cash Flows from Financing Activities and Dividends:** | | | |
| Debt transactions: | | | |
| Proceeds from long-term debt | **—** | — | 25,451 |
| Long-term debt assumed in business acquisition | **17,121** | — | — |
| Repayments of debt | **(36,249)** | (101,776) | (237,956) |
| Increase (decrease) in short-term borrowings | **—** | (100,000) | 100,000 |
| Equity transactions: | | | |
| Issuance of common stock | **9,594** | 11,079 | 30,573 |
| Purchases of common stock for treasury | **(21,355)** | (120,689) | — |
| Proceeds from sold operations, net of gain | **38,688** | 87,006 | 49,908 |
| Dividends paid on common and preferred stock | **(55,164)** | (57,938) | (58,052) |
| **Net Cash Used for Financing Activities and Dividends** | **(47,365)** | (282,318) | (90,076) |
| **Discontinued Operation:** | | | |
| Decrease in net assets and, in 1984, losses from discontinued operation | **14,499** | 145,739 | 242,082 |
| Decrease (increase) in other current and noncurrent assets relating to proceeds from sale | **18,671** | 311,575 | (328,281) |
| **Cash Flows and Change in Net Assets of Discontinued Operation** | **33,170** | 457,314 | (86,199) |
| **Net Increase (Decrease) in Cash and Short-term Investments** | **$ 56,830** | $107,910 | $ (8,893) |

*The notes on pages 21 to 31 are integral parts of these statements.*

**Martin Marietta Corporation** and Consolidated Subsidiaries

**Robert Evick inspects control sections for the Copperhead laser-guided projectile at Ocala, Florida, before the highly accurate artillery shells are delivered to the Army.**

# Statement of Shareowners' Equity

for years ended December 31

(add 000)

| | Preferred Stock | Common Stock | Additional Paid-in Capital | Retained Earnings | Treasury Common Stock | Total Shareowners' Equity |
|---|---|---|---|---|---|---|
| **Balance at January 1, 1984** | $115,000 | $ 69,488 | $570,233 | $1,132,226 | $(1,041,591) | $845,356 |
| Net loss for 1984 | — | — | — | (191,764) | — | (191,764) |
| Cash dividends declared on common stock ($.893 a share) | — | — | — | (46,839) | — | (46,839) |
| Cash dividends declared on preferred stock ($4.875 a share) | — | — | — | (11,213) | — | (11,213) |
| Stock options exercised, net of stock tendered in payment (454,013 shares from treasury) | — | — | (2,089) | — | 8,709 | 6,620 |
| Common stock issued under other employee benefit plans (949,236 shares from treasury) | — | — | 4,218 | — | 18,769 | 22,987 |
| Other issuances of common stock (34,742 shares from treasury) | — | 4 | 275 | — | 687 | 966 |
| **Balance at December 31, 1984** | 115,000 | 69,492 | 572,637 | 882,410 | (1,013,426) | 626,113 |
| Net earnings for 1985 | — | — | — | 249,392 | — | 249,392 |
| Cash dividends declared on common stock ($.973 a share) | — | — | — | (55,135) | — | (55,135) |
| Cash dividends declared on preferred stock ($1.219 a share) | — | — | — | (2,803) | — | (2,803) |
| Stock options exercised, net of stock tendered in payment (389,011 shares from treasury) | — | — | 3,116 | — | 7,475 | 10,591 |
| Common stock issued under other employee benefit plans (41,462 shares from treasury) | — | — | 410 | — | 819 | 1,229 |
| Other issuances of common stock | — | 2 | 50 | — | — | 52 |
| Conversion of preferred stock to common stock, net of expenses, and $27,000 paid for shares redeemed | (115,000) | 3,449 | 111,168 | (27) | — | (410) |
| Issuance of shares to effect 3-for-2 stock split, and $383,000 paid in lieu of fractional share interests | — | 36,461 | — | (36,844) | — | (383) |
| Common stock purchased for treasury (3,427,500 shares) | — | — | — | — | (120,689) | (120,689) |
| **Balance at December 31, 1985** | — | 109,404 | 687,381 | 1,036,993 | (1,125,821) | 707,957 |
| Net earnings for 1986 | — | — | — | 202,344 | — | 202,344 |
| Cash dividends declared on common stock ($1.00 a share) | — | — | — | (55,164) | — | (55,164) |
| Stock options exercised, net of stock tendered in payment (304,352 shares from treasury) | — | — | 3,428 | — | 6,130 | 9,558 |
| Other issuances of common stock | — | — | 36 | — | — | 36 |
| Common stock purchased for treasury (531,250 shares) | — | — | — | — | (21,355) | (21,355) |
| **Balance at December 31, 1986** | **$ —** | **$109,404** | **$690,845** | **$1,184,173** | **$(1,141,046)** | **$843,376** |

# Report of Independent Auditors

Board of Directors and Shareowners
Martin Marietta Corporation:

We have examined the consolidated balance sheet of Martin Marietta Corporation and consolidated subsidiaries as of December 31, 1986 and 1985, and the related consolidated statements of operations, shareowners' equity, and cash flows for each of the three years in the period ended December 31, 1986. Our examinations were made in accordance with generally accepted auditing standards and, accordingly, included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances. The financial statements of Martin Marietta Aluminum Inc. and consolidated subsidiaries reflect the principal portion of losses from the discontinued operation in 1984. These statements were examined by other auditors whose report thereon has been furnished to us, and our opinion expressed herein, insofar as it relates to the amounts included for Martin Marietta Aluminum Inc. and consolidated subsidiaries, is based solely upon the report of other auditors.

In our opinion, based upon our examinations and the aforementioned report of other auditors, the financial statements referred to above present fairly the consolidated financial position of Martin Marietta Corporation and consolidated subsidiaries at December 31, 1986 and 1985, and the consolidated results of their operations and cash flows for each of the three years in the period ended December 31, 1986, in conformity with generally accepted accounting principles applied on a consistent basis.

Ernst & Whinney

Washington, D.C.
January 19, 1987

**Air controllers direct traffic at the Federal Aviation Administration's busy New York area control center, one of 23 across the country being updated as part of a sweeping modernization of the nation's air traffic control system. Martin Marietta is systems engineering and integration contractor on the program.**

# Notes to Financial Statements

**Martin Marietta Corporation** and Consolidated Subsidiaries

## Note A: Accounting Policies

**Consolidation Basis** Consolidated financial statements include the accounts of all significant subsidiaries except a real estate subsidiary and a metals fabrication joint venture (see Note F).

**Investments Valuation** Short-term investments are carried at cost which approximates market value. Long-term investments in marketable equity securities are carried at the lower of aggregate cost or market value. Specific costs are used to compute realized gains or losses.

Investments in all nonconsolidated subsidiaries and joint ventures and in associated companies are accounted for by the equity method wherever the Corporation is able to exercise significant influence over operating and financial matters. Other miscellaneous investments are carried at cost less valuation allowances where appropriate.

**Revenues Recognition** Sales under long-term contracts generally are recognized under percentage-of-completion methods and include a proportion of the earnings expected to be realized on the contract in the ratio that costs incurred bear to estimated total costs. Sales are recorded on cost-type contracts as costs are incurred and on fixed-price-type contracts when deliveries are made or work is performed. Contracts in progress are reviewed quarterly, and sales and earnings are adjusted in current accounting periods based on revisions in contract value and estimated costs at completion. Performance incentives are incorporated in certain contracts and are recognized when incentives are earned or awarded or penalties are incurred or assessed. Provisions for estimated losses on contracts are recorded when identified.

Other sales are recorded upon shipment of products or performance of services.

**Inventories Valuation** Inventories are stated at the lower of cost or market. Costs on long-term aerospace contracts in progress represent recoverable costs incurred for production, research and development, and selling, general, and administration, less amounts attributed to cost of sales, generally under percentage-of-completion accounting methods. Costs of other product and supply inventories are principally determined by the first-in, first-out (FIFO) method.

**Properties and Depreciation** Property, plant, and equipment, including capital leases, are carried at cost which includes interest cost capitalized during construction on significant capital expenditures.

Depreciation and amortization of properties are computed over estimated service lives by accelerated methods in the aerospace and information systems businesses and by the straight-line method in the other businesses.

Depletion of mineral deposits is calculated over estimated recoverable quantities by the unit-of-production method.

**Income Taxes** Current income tax provisions represent estimated amounts payable or recoverable for each year after reductions for investment credits under the flow-through method and for other permanent differences. Deferred income tax provisions represent the tax effect of all significant timing differences between financial and current taxable earnings.

Deferred federal income taxes are provided on the basis of investment policies or dividend distributions from subsidiaries and associated companies not consolidated in the federal income tax return.

**Intangibles Amortization** Costs of investments in excess of net assets of acquired businesses are amortized ratably over periods not to exceed 40 years.

**Research and Development and Similar Costs** Research and development and similar costs are charged to operations as incurred unless reimbursable under contractual arrangements. Independent research and development, systems studies, other concept formulation studies, and bid and proposal work relating to government contracts represent a major portion of these expenses. Such amounts are allocated when appropriate to government contracts through overhead under government-mandated cost accounting procedures.

Preoperating costs are generally charged to operations as incurred, except that such costs for significant new commercial products or services and start-up costs of certain facilities are deferred for amortization over periods not to exceed five years.

**Earnings Per Common Share** Net earnings per common share are based on the weighted average number of common shares outstanding during the year. Earnings per share, assuming no dilution, were computed in 1984 and 1985 based on net earnings less the dividend requirement of preferred stock. Fully diluted earnings per share in 1984 assumed that the average number of common shares was increased by the conversion of preferred stock from the beginning of the year and by dilutive stock options.

## Note B: Cash and Short-term Investments

Cash and short-term investments are comprised principally of money market instruments of less than one-year maturity.

Cash in excess of operating requirements, including amounts required to fund the Corporation's outstanding checks when presented for payment, is invested in short-term instruments. At December 31, 1986, book cash balances amounted to net overdrafts of $8,080,000, which are attributable to the float of the Corporation's outstanding checks. There was no net book cash overdraft at December 31, 1985.

# Notes to Financial Statements

## Note C: Discontinued Operation

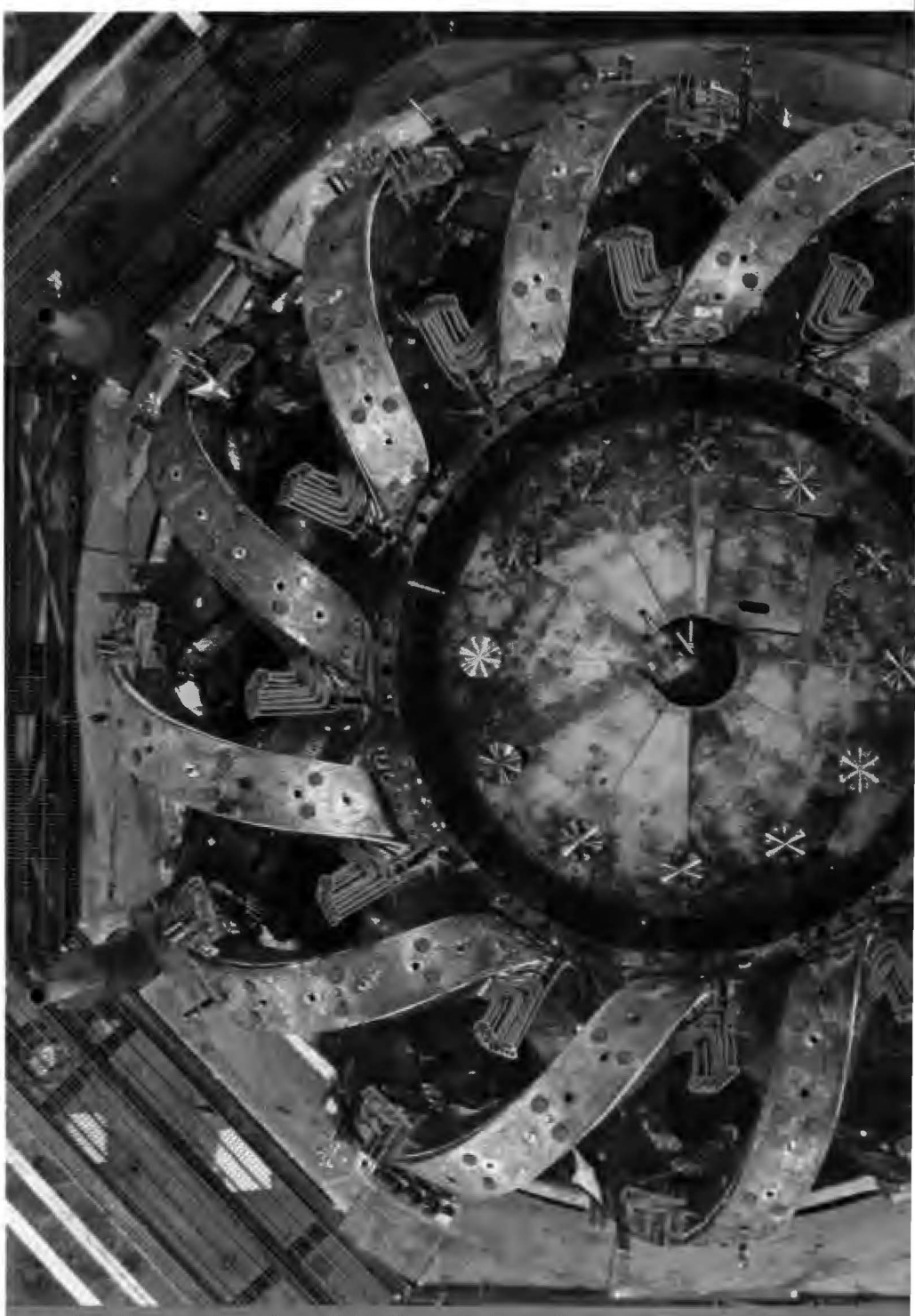
In 1984, the Corporation withdrew from the aluminum business under a divestiture plan approved by the Board of Directors. A reserve of $365,000,000, net of tax benefits of $283,000,000, was established to provide for losses on dispositions and other costs expected to be incurred in completing the Corporation's disengagement from the aluminum business.

In December, 1984, the Corporation sold its wholly owned subsidiary, Martin Marietta Aluminum Inc., to Comalco Limited of Australia. This subsidiary's assets included four major facilities plus other assets. The Corporation realized $330,000,000 in cash and notes receivable from Comalco and, also under terms of the sale, realized approximately $36,000,000 in 1985 from liquidation of receivables and inventories from these sold operations after expenses.

In March, 1985, the Corporation sold its share in a California joint venture carbon plant for $28,000,000 in cash.

By December 31, 1986, disposition of the last two facilities was completed. An alumina refinery in the Virgin Islands was sold for $45,000,000, with the cash transaction scheduled for closing by the end of the first quarter of 1987. Additionally, the Corporation entered into a lease-purchase agreement for its smelter in Oregon.

Net sales of the discontinued operation were $496,126,000 for the first nine months of 1984. In reporting the results for the discontinued operation, losses were adjusted for a reallocation of interest expense between discontinued and continuing operations.



**A 22-foot-diameter Advanced Toroidal Facility, or "stellarator," under construction at Oak Ridge National Laboratory, will use an intense magnetic field to contain hydrogen plasma at 10 to 40 million degrees centigrade in a nuclear fusion research program aimed at future energy production.**

## Note D:
## Notes and Accounts Receivable (add 000)

| | 1986 | 1985 |
|---|---|---|
| Receivables under long-term contracts: | | |
| United States Government: | | |
| Amounts billed | **$118,522** | $129,624 |
| Recoverable costs and accrued profits not billed | **236,451** | 128,793 |
| Amounts withheld, due upon completion of contracts | **9,800** | 10,922 |
| | **364,773** | 269,339 |
| Other customers: | | |
| Amounts billed | **20,374** | 25,268 |
| Recoverable costs and accrued profits not billed | **57,308** | 58,245 |
| Total receivables under long-term contracts | **442,455** | 352,852 |
| Less noncurrent amounts | **107,039** | 7,690 |
| | **335,416** | 345,162 |
| Commercial accounts receivable | **77,022** | 96,100 |
| Notes and other current receivables | **13,446** | 24,375 |
| | **425,884** | 465,637 |
| Less allowances | **4,282** | 5,827 |
| Total | **$421,602** | $459,810 |

Recoverable costs and accrued profits not billed will be billed on the basis of contract terms and delivery schedules. Amounts due after one year are classified noncurrent.

The provision for uncollectible receivables was $3,290,000 in 1986, $4,110,000 in 1985, and $2,290,000 in 1984.

## Note E:
## Inventories (add 000)

| | 1986 | 1985 |
|---|---|---|
| Costs on contracts in progress | **$354,614** | $293,103 |
| Less progress payments | **43,633** | 27,401 |
| | **310,981** | 265,702 |
| Finished products | **27,037** | 21,687 |
| Products in process and raw materials | **10,504** | 14,318 |
| Expendable parts and supplies | **15,471** | 15,987 |
| Total | **$363,993** | $317,694 |

Title with respect to contracts-in-progress inventories of approximately $45,730,000 for 1986 and $53,200,000 for 1985 has been transferred to the U.S. Government.

Costs on contracts in progress at December 31, 1986 and 1985, did not include any significant amounts of production costs, unamortized tooling, other deferred costs, or claims and similar items subject to uncertainty concerning their realization.

Selling, general, and administrative costs in connection with production under aerospace long-term contracts were charged to inventories as incurred in the amounts of $222,350,000 in 1986 and $201,600,000 in 1985. The estimated amounts remaining in inventories were $15,770,000 at December 31, 1986, and $11,760,000 at December 31, 1985.

# Notes to Financial Statements

## Note F: Investments (add 000)

| | 1986 | 1985 |
|---|---|---|
| Marketable investment securities | **$ 57,777** | $ 51,506 |
| Other investments | | |
| Nonconsolidated subsidiaries: | | |
| International Light Metals Corporation | **64,846** | 69,863 |
| Orlando Central Park, Inc. | **46,976** | 37,952 |
| Other | **924** | 1,033 |
| Associated companies: | | |
| Equatorial Communications Company | **39,156** | 50,000 |
| Other | **8,702** | 9,102 |
| Biotechnology companies | **18,866** | 25,776 |
| Miscellaneous investments | **2,970** | 1,283 |
| Total | **$240,217** | $246,515 |

| Summarized data (millions): | Nonconsolidated Subsidiaries | | | Associated Companies | | |
|---|---|---|---|---|---|---|
| | **1986** | 1985 | 1984 | **1986** | 1985 | 1984 |
| Current assets | **$ 76.3** | $ 90.1 | | **$60.3** | $ 56.6 | |
| Noncurrent assets | **155.3** | 149.0 | | **80.7** | 82.3 | |
| Current liabilities | **21.7** | 17.2 | | **19.7** | 15.7 | |
| Noncurrent liabilities | **53.0** | 56.4 | | **18.6** | 10.3 | |
| Revenues | **144.4** | 155.9 | $171.2 | **77.5** | 68.1 | $113.5 |
| Gross profit (loss) | **(3.9)** | 4.4 | 13.8 | **9.4** | 15.5 | 48.7 |
| Net earnings (losses) | **(9.1)** | .4 | 6.7 | **(29.3)** | 2.4 | 3.5 |
| Equity in net earnings (losses) (Note M) | **(7.0)** | 2.0 | 6.1 | **(11.3)** | .1 | 1.1 |

Marketable investment securities consist principally of a portfolio of common stock of other publicly traded companies held for long-term investment. At December 31, 1986, aggregate market value approximated cost.

International Light Metals Corporation, located in Torrance, California, is a joint venture between Nippon Kokan KK of Japan (40% interest) and Martin Marietta (60% interest) established for the purpose of utilizing the technologies and expertise of both companies for the production and marketing of fabricated metal products.

Orlando Central Park, Inc., a wholly owned subsidiary, develops properties near Orlando, Florida.

Equatorial Communications Company, in which the Corporation owns a 25% equity interest, provides satellite-based communications networks. Its principal location is at Mountain View, California. At December 31, 1986, the unamortized excess of Martin Marietta's carrying value over the underlying equity in net assets was approximately $18,000,000; the quoted market value of this investment was $12,600,000.

Investments in biotechnology companies at December 31, 1986, represent the Corporation's minority interest share, under 20%, in two companies engaged in research and manufacture of agricultural and health care products. These investments are carried at cost. In 1986, the Corporation sold at a gain its investment in a third biotechnology company which was purchased prior to 1985 (see Note M).

**Precision mirrors, being removed from an electrochemical bath by Kurt Irlesberger at Orlando, are key components of laser-guided missiles.**

The Corporation's share of undistributed earnings of nonconsolidated subsidiaries and associated companies included in retained earnings was $41,520,000 at December 31, 1986.

## Note G:
## Debt (add 000)

| | 1986 | 1985 |
|---|---|---|
| 7% Debentures due 2011 | **$ 96,150** | $ 95,706 |
| Adjustable Rate Notes | **68,465** | 68,465 |
| 12⅛% Note | **—** | 25,000 |
| 5⅞% Sinking Fund Debentures due 1992 | **15,944** | 15,944 |
| 8⅝% Real Estate Mortgage due 2012 | **19,369** | 19,576 |
| Industrial Development Revenue Bonds | **18,800** | 18,800 |
| Other notes and capital lease obligations | **11,975** | 3,463 |
| Total | **230,703** | 246,954 |
| Less current maturities | **3,003** | 26,541 |
| Long-term debt | **$227,700** | $220,413 |

The 7% Debentures were sold at 53.835% of their principal amount of $175,000,000 in 1981. These debentures are carried net of original issue debt discount, which is being amortized by the interest method over the life of the issue. The effective interest rate is 13.25%. The debentures are redeemable in whole or in part at the Corporation's option at any time at 100% of their principal amount.

The Adjustable Rate Notes interest rate was reduced from 12.25% to 7.25% on May 1, 1986. The interest rate is adjustable biennially based on a percentage of the prevailing two-year U.S. Treasury rate, not to exceed 109% of that rate. The notes, which are due in 1994, may be redeemed at par on May 1, 1988, by either the Corporation or the holders. On each succeeding biennial anniversary the notes may be redeemed at par by the Corporation and, under certain circumstances, by the holders.

The 5⅞% Sinking Fund Debentures' principal and interest payments to maturity in 1992 will be provided from an irrevocable trust into which the Corporation deposited U.S. Government obligations in 1981 in an amount sufficient to meet this debt service. This deposit is included in other noncurrent assets.

The 8⅝% Real Estate Mortgage is payable in monthly installments of approximately $157,000, including interest, and is secured by property in Maryland having a net book value of $21,010,000 at December 31, 1986.

Industrial Development Revenue Bonds, issued to finance various construction projects throughout the Corporation for environmental and industrial development purposes, mature after the year 2000 and have an average effective interest rate of 7.7%.

Maturities of long-term debt during the five-year period ending December 31, 1991, after application of treasury bonds and funds in an irrevocable trust to sinking fund requirements and assuming redemption of the Adjustable Rate Notes in 1988, are: $3,003,000 in 1987, $70,051,000 in 1988, $1,570,000 in 1989, $1,639,000 in 1990, and $1,371,000 in 1991.

Interest expense on debt for continuing operations was net of capitalized interest of $4,876,000 in 1986, $5,580,000 in 1985, and $4,815,000 in 1984 and included commitment fees of $938,000 in 1986, $939,000 in 1985, and $991,000 in 1984.

A $500,000,000 Revolving Credit and Term Loan Agreement may be used for general corporate purposes, including working capital and back-up for commercial paper. This agreement with a group of banks provides for a revolving line of credit through December, 1988, and has, subject to certain conditions, an additional five-year term option. Loans may be paid and re-borrowed during the revolving credit period. Under terms of the additional five-year option, repayment shall be in 10 equal, semi-annual installments ending December 31, 1993. Under this agreement, options are available to borrow at variable rates based on prime and on spreads over the banks' cost of funds.

The financing agreements of Martin Marietta Corporation contain certain restrictive covenants, including requirements for limitations on encumbrances and on sale and leaseback transactions.

Under the Revolving Credit and Term Loan Agreement, Martin Marietta is also subject to limitations on the Corporation's financial leverage as defined by the Agreement.

## Note H: Contingencies

All litigation pending against Martin Marietta and its subsidiaries is not considered to be material and, in the opinion of management and counsel, will not have a significant effect upon the financial position of the Corporation.

## Note I: Leases

Total rental expense for all operating leases was $124,970,000 in 1986, $112,170,000 in 1985, and $96,830,000 in 1984. Rental expense included contingent rentals based primarily on equipment usage of approximately $1,000,000 in each year.

Future minimum rental commitments for all noncancelable operating leases are: $83,590,000 for 1987, $62,600,000 for 1988, $42,500,000 for 1989, $23,630,000 for 1990, $14,910,000 for 1991, and $48,740,000 for later years.

# Notes to Financial Statements

## Note J: Shareowners' Equity

The authorized capital structure of Martin Marietta Corporation includes 20,000,000 shares of Series Preferred Stock with par value of $1 a share, none of which has been issued.

In March, 1986, the Board of Directors authorized two separate purchases of the Corporation's common stock: the purchase for treasury of up to 1,500,000 shares to be used for general corporate purposes and the purchase by the Martin Marietta Retirement Trust of up to 1,500,000 shares for the pension trust. Shares under both of these authorizations will be purchased from time to time in the open market and through privately negotiated transactions. Through December 31, 1986, 477,550 shares had been purchased for the Retirement Trust and 477,550 shares had been repurchased for treasury, including 350,700 shares purchased under the 1986 authorization. In addition, the Board of Directors authorized in 1985 the purchase from time to time of up to 3,300,000 shares of common stock for anticipated exercise under the Corporation's Stock Option Plans. By December 31, 1986, 608,050 shares had been purchased under this authorization.

In 1985, the Corporation authorized and completed a common stock repurchase of 3,000,000 shares at a cost of $103,847,000. These shares are held in treasury for general corporate purposes.

In July, 1986, the Board of Directors adopted a Shareholder Rights Plan to distribute one Common Stock Purchase Right for each outstanding share of the Corporation's common stock. The Rights are exercisable only if a person or group acquires, in a transaction not approved by the Board, 20% or more of the Corporation's common stock or announces a tender offer for 30% or more of the common stock. When exercisable, each Right entitles shareholders to purchase one share of the Corporation's common stock at a current exercise price of $150. The Corporation will be entitled to redeem the Rights at $.05 per Right up to and including the tenth business day after a 20% position has been acquired. If the Corporation is acquired or certain other transactions occur, after the Rights become exercisable, each Right will entitle its holder to purchase, for the exercise price, a number of the acquiring or surviving company's common shares having a market value of twice the exercise price. The Rights were issued on August 4, 1986, to shareholders then of record and attach to each share issued thereafter until the earlier of the dates the Rights become exercisable, expire, or are redeemed. The Rights will expire on August 4, 1996, unless extended by the Board of Directors.

At December 31,1986, approximately $790,000,000 of retained earnings was available for dividend payment.

## Note K: Stock Option Plans

Martin Marietta grants to officers and key employees options to purchase its common stock under plans adopted by the shareowners. The plans provide that the options shall be granted at a price equal to the market value at date of grant, shall become exercisable in three equal annual installments beginning one year after date of grant, and shall expire 10 years from such date. The 1974 and 1984 Plans provide for financing of purchases under certain conditions by interest-bearing notes payable to the Corporation.

The 1979 and 1984 Plans include stock appreciation rights which are granted simultaneously in equal number with the grant of stock options. These rights may be exercised only with the options and entitle a grantee to receive in cash an amount equal to a percentage of the increase in the market value of the Corporation's common stock. The 1979 Plan limits these payments to 100% of the option price.

| | Number of Shares | | Option Price | |
|---|---|---|---|---|
| | Available for Grant | Options Outstanding | Per Share Range | Total (add 000) |
| YEAR 1985: | | | | |
| January 1 | 1,409,588 | 2,186,138 | $ 4.33—$28.00 | $45,492 |
| Granted | (529,000) | 529,000 | 31.75— 39.50 | 20,818 |
| Exercised | — | (404,188) | 4.33— 28.00 | 5,943 |
| Canceled | 192,775 | (192,775) | 10.61— 39.50 | 4,486 |
| Expired | (19,050) | — | | |
| December 31 | 1,054,313 | 2,118,175 | 7.93— 39.50 | 55,881 |
| Exercisable at December 31 | | 962,502 | | |
| YEAR 1986: | | | | |
| January 1 | 1,054,313 | 2,118,175 | $ 7.93—$39.50 | $55,881 |
| Granted | (528,500) | 528,500 | 33.00— 43.88 | 22,705 |
| Exercised | — | (317,939) | 7.93— 28.00 | 5,797 |
| Canceled | 14,400 | (14,400) | 23.33— 39.50 | 463 |
| Expired | (600) | — | | |
| December 31 | 539,613 | 2,314,336 | 7.93— 43.88 | 72,326 |
| Exercisable at December 31 | | 1,240,238 | | |

## Note L: Retirement Plans

Martin Marietta and its consolidated subsidiaries have a number of retirement plans which cover substantially all employees. Defined benefit plans for salaried employees provide benefits based on employees' years of service and average compensation for a specified period of time before retirement. Defined benefit plans for hourly paid employees generally provide benefits of stated amounts for specified periods of service.

In December, 1986, the Corporation adopted Statement of Financial Accounting Standards No. 87, "Employers' Accounting for Pensions" (FAS 87) for reporting in connection with its defined benefit pension plans, retroactive to January 1, 1986. Pension costs and related disclosures for these plans for 1986 were determined under the provisions of this Standard. The effect of this adoption was to reduce pension cost by approximately $16,000,000, resulting in an $8,800,000 increase in net earnings, or $.16 per share.

The methodology and effects of FAS 87 are not consistent with the Corporation's general funding policy, which complies with the Employee Retirement Income Security Act of 1974 (ERISA) and Cost Accounting Standards. This policy is to contribute to the Corporation's retirement plans amounts at least equal to the minimum funding requirements set forth in ERISA and to stabilize contributions as a percentage of payroll by utilizing the entry age normal actuarial cost method and by selecting actuarial assumptions on the basis of long-term trends.

FAS 87 specifies that the projected unit credit actuarial cost method be used for the determination of pension expense for financial reporting purposes. In addition, certain key actuarial assumptions are assessed annually to reflect current shifts in the economy. These attributes of FAS 87 can result in a pension expense for reporting purposes which is less than the minimum funding requirements of ERISA (which occurred in 1986) as well as contribute to significant year-to-year pension expense fluctuations.

The net pension cost of defined benefit plans for 1986 included the following components:

| | (add 000) |
|---|---|
| Service cost—benefits earned during the period | $ 77,830 |
| Interest cost | 100,123 |
| Amortization of transition asset | (3,797) |
| Actual return on assets, net of deferred gain of $53,835,000 | (104,661) |
| Net pension cost | $ 69,495 |

Pension costs for 1985 and 1984, determined under prior accounting principles, were $90,800,000 and $77,150,000, respectively.

The following table sets forth the defined benefit plans' funded status and amounts recognized in the Corporation's consolidated balance sheet as of December 31, 1986:

| | (add 000) |
|---|---|
| Actuarial present value of benefit obligations: | |
| Vested | $1,088,674 |
| Non-vested | 119,135 |
| Accumulated Benefit Obligation (ABO) | 1,207,809 |
| Effect of estimated future pay increases | 420,923 |
| Projected Benefit Obligation (PBO) | 1,628,732 |
| Plan assets at fair value | (1,568,942) |
| Excess of PBO over assets | 59,790 |
| Unrecognized net asset | 62,881 |
| Unrecognized 1986 loss | (115,497) |
| Accrued pension cost | $ 7,174 |

The actuarial present value of the PBO was determined by using weighted average discount rates that ranged from 5.7% to 7.6% and assuming a 5.25% rate of increase for future compensation levels. The expected long-term rate of return on assets was 7.5%. Plan assets at December 31, 1986, are invested principally in listed stocks and bonds. Investments in the Corporation's common stock accounted for 7% of plan assets at December 31, 1986.

As of December 31, 1985, the actuarial present value of accumulated plan benefits was determined based upon the range of Pension Benefit Guaranty Corporation interest rates in effect on September 30, 1985, (from 4% to 9.25%) and was $1,108,000,000, including vested benefits of $980,000,000. The actuarial present value of projected plan benefits included the effect of projected pay increases and was $1,505,000,000. The plans' net assets available for benefits totaled $1,398,000,000.

Martin Marietta and its consolidated subsidiaries also provide certain life insurance and health care benefits for retired employees. Employees may become eligible for such benefits if employed by the Corporation or one of its consolidated subsidiaries at retirement age. The Corporation has provided for these benefits by expensing the costs on a pay-as-you-go basis. These costs were $11,000,000 in 1986, $9,300,000 in 1985, and $7,500,000 in 1984.

**Gail Bates inspects laser seekers developed by Martin Marietta for the Army's Hellfire anti-armor missiles. The Corporation also co-produces the air-to-surface missile.**

# Notes to Financial Statements

## Note M: Other Income and Expenses (add 000)

| | 1986 | 1985 | 1984 |
|---|---|---|---|
| Interest income | **$ 9,732** | $ 33,844 | $ 6,763 |
| Equity in earnings (losses) of nonconsolidated subsidiaries and associated companies | **(18,286)** | 2,119 | 7,231 |
| Gain (loss) from sales of operations | **(1,881)** | 102,994 | 18,565 |
| Gain from sales of investments | **21,144** | 2,786 | — |
| Gain from sales of technology | **5,090** | 8,400 | 2,500 |
| Gain from dispositions of properties | **1,011** | 747 | 5,526 |
| Royalties | **2,212** | 2,630 | 2,976 |
| Miscellaneous, net | **(1,140)** | 6,770 | 11,272 |
| Total | **$17,882** | $160,290 | $54,833 |

Interest income was greater in 1985 as a result of higher short-term investment balances and notes received on sale of the discontinued operation.

Equity in earnings (losses) of nonconsolidated subsidiaries and associated companies included earnings from Orlando Central Park, Inc., of $4,390,000 in 1985 and $8,670,000 in 1984; losses of International Light Metals Corporation of $5,820,000 in 1986, $2,530,000 in 1985, and $2,200,000 in 1984 ; and estimated losses related to Equatorial Communications Company of $11,100,000 in 1986. Dividends received from nonconsolidated subsidiaries and associated companies were $250,000 in 1986, $175,000 in 1985, and $1,630,000 in 1984.

Gain (loss) from sales of operations in 1986 included a loss of $13,055,000 from sale of the Data Systems company's packaged software business, net of $11,174,000 gained from the sale of a minority interest of 25% in Hoskyns Group Limited, a computer services company based in the United Kingdom. In 1985 the gain was from sale of the Master Builders division and in 1984 from disposition of two cement operations.

Gain from sales of investments in 1986 was primarily from sale of the Corporation's minority interest in a California-based biotechnology company and in 1985 was from sale of a mica mining and processing business in Canada.

Nonrecurring net gain in other income and expenses, primarily from sales of operations and, in 1986, sale of a biotechnology investment, of $15,673,000 in 1986, $102,994,000 in 1985, and $22,529,000 in 1984 contributed $15,900,000, or $.29 per share, in 1986, $73,000,000, or $1.29 per share, in 1985, and $11,500,000, or $.22 per share, in 1984 to earnings from continuing operations.

In 1986, miscellaneous includes $8,790,000 of interest expense resulting from a revenue agent's review.

## Note N: Selling, General, and Administrative Expenses

Selling, general, and administrative expenses in cost of sales, other costs, and expenses were $401,630,000 for 1986, $380,970,000 for 1985, and $355,790,000 for 1984.

## Note O: Research and Development Expenses

Research and development expenses in cost of sales, other costs, and expenses were $218,870,000 in 1986, $176,150,000 in 1985, and $147,740,000 in 1984 and included independent research and development, systems studies, other concept formulation studies, and bid and proposal work related to government contract products and services.

**Orlando design engineer Robert Yokomoto examines the diagram for a very large scale integrated circuit that will be reduced to a single chip layer with circuit lines one-fiftieth the thickness of a human hair.**

## Note P:
## Taxes on Income (add 000)

| | 1986 | 1985 | 1984 |
|---|---|---|---|
| Federal income taxes: | | | |
| Current | **$ 49,450** | $ 82,490 | $ 98,930 |
| Deferred | **55,900** | 64,940 | 20,540 |
| Total federal income taxes | **105,350** | 147,430 | 119,470 |
| State income taxes: | | | |
| Current | **9,000** | 2,700 | 5,590 |
| Deferred | **8,400** | 17,400 | 4,610 |
| Total state income taxes | **17,400** | 20,100 | 10,200 |
| Foreign income taxes | **2,350** | 1,370 | 3,230 |
| Total income taxes provided for continuing operations | **$125,100** | $168,900 | $132,900 |

The Corporation's effective income tax rate for continuing operations varied from the statutory United States income tax rate because of the following permanent tax differences:

| | | | |
|---|---|---|---|
| Statutory tax rate | **46.0%** | 46.0% | 46.0% |
| Increase (reduction) in tax rate from: | | | |
| Prior-year overprovision, principally as a result of the Woods Investment decision | **(6.2)** | — | — |
| Investment tax credits | **(1.3)** | (3.0) | (4.0) |
| Capital gain income | **(1.7)** | ( .4) | (.9) |
| Nonrecurring sales of assets[1] | **(2.2)** | (4.1) | .1 |
| State income taxes | **2.5** | 1.5 | 1.6 |
| Other items | **1.1** | .4 | .2 |
| | **(7.8)** | (5.6) | (3.0) |
| Effective tax rate | **38.2%** | 40.4% | 43.0% |

| | | | |
|---|---|---|---|
| Deferred federal and state tax provisions related to the tax effects of: | | | |
| Deferral of profits on long-term contracts[2] | **$50,270** | $70,900 | $ (5,010) |
| Investment tax credits | **—** | — | (9,660) |
| R & D credits | **—** | — | 4,100 |
| Accelerated depreciation currently deducted for taxes | **16,410** | 16,820 | 13,300 |
| Pension contributions currently deducted for taxes | **10,010** | — | — |
| Gain on sales reported under installment method | **(1,200)** | (850) | 10,990 |
| Miscellaneous | **(11,190)** | (4,530) | 11,430 |
| | **$64,300** | $82,340 | $25,150 |

[1]Nonrecurring sales of assets included: in 1986, sale of the Corporation's investment in a biotechnology company, sale of the packaged software business, and sale of a 25% minority interest in Hoskyns Group Limited; in 1985, sale of the Master Builders division; and in 1984, disposition of cement operations (see Note M).

[2]Profits on long-term contracts are reported on the completed-contract basis for taxes. The amounts also include the effect of the deduction for taxes of certain costs in contracts-in-progress inventories.

A recent Federal Tax Court decision, *Woods Investment Company v. Commissioner,* had the effect of reducing the tax on the gain the Corporation realized from the sale of the Master Builders division in 1985. The Corporation has approximately $107,000,000 of available capital loss carryforward.

Investment tax credits were $4,140,000 in 1986, $10,660,000 in 1985, and $11,090,000 in 1984.

Deferred taxes included in the current income tax liability at December 31 were $192,250,000 in 1986 and $148,290,000 in 1985.

Deferred income taxes relating to contracts are classified as current if the related contract is expected to be completed within the following year; otherwise, they are classified as noncurrent.

Foreign earnings before taxes on income were $4,410,000 in 1986, $3,080,000 in 1985, and $2,430,000 in 1984. Provisions for foreign income taxes were primarily for current taxes payable.

The Corporation has not provided deferred income taxes on accumulated undistributed earnings of $20,230,000 at December 31, 1986, in certain subsidiaries and associated companies; such earnings are deemed to have been permanently reinvested in these businesses.

# Notes to Financial Statements

## Note Q: Industry Segments (millions)

| | Net Sales[1] | | | Operating Profit[2] | | | Assets Employed | | |
|---|---|---|---|---|---|---|---|---|---|
| | **1986** | 1985 | 1984 | **1986** | 1985 | 1984 | **1986** | 1985 | 1984 |
| Aerospace Systems: | | | | | | | | | |
| Space and Strategic | **$1,831.0** | $1,790.1 | $1,767.3 | **$136.2** | $154.7 | $157.3 | **$ 442.6** | $ 397.2 | $ 267.3 |
| Defense Electronics and Tactical | **1,500.4** | 1,347.3 | 1,018.3 | **166.0** | 131.9 | 90.1 | **637.3** | 552.7 | 339.4 |
| Aero-Mechanical | **379.7** | 343.9 | 310.0 | **37.5** | 33.1 | 34.7 | **186.2** | 172.1 | 123.0 |
| | **3,711.1** | 3,481.3 | 3,095.6 | **339.7** | 319.7 | 282.1 | **1,266.1** | 1,122.0 | 729.7 |
| Information Systems: | | | | | | | | | |
| Data Systems | **467.4** | 429.9 | 361.6 | **(3.7)**[3] | (10.3) | 18.9 | **147.0** | 209.3 | 173.6 |
| Information & Communications[4] | **421.2** | 325.7 | 177.1 | **12.7** | 19.5 | 6.8 | **66.0** | — | — |
| | **888.6** | 755.6 | 538.7 | **9.0** | 9.2 | 25.7 | **213.0** | 209.3 | 173.6 |
| Materials: | | | | | | | | | |
| Construction Aggregates | **239.2** | 199.7 | 189.0 | **63.2** | 53.5 | 47.5 | **181.2** | 141.8 | 144.1 |
| Magnesia Specialties | **104.9** | 111.5 | 130.5 | **6.9** | (6.1)[5] | 4.1 | **104.2** | 117.8 | 132.8 |
| Other[6] | **—** | 21.8 | 109.4 | **(.4)** | 102.9[7] | 35.1[7] | **91.7** | 101.5 | 163.6 |
| | **344.1** | 333.0 | 428.9 | **69.7** | 150.3 | 86.7 | **377.1** | 361.1 | 440.5 |
| Total operating segments | **4,943.8** | 4,569.9 | 4,063.2 | **418.4** | 479.2 | 394.5 | **1,856.2** | 1,692.4 | 1,343.8 |
| Corporate[8] | **37.9** | 31.4 | 17.4 | **(72.7)** | (30.1) | (60.6) | **374.3** | 304.7 | 560.1 |
| Intersegment sales[9] | **(229.2)** | (191.2) | (160.2) | | | | | | |
| Net sales | **$4,752.5** | $4,410.1 | $3,920.4 | | | | | | |
| Investments | | | | **2.9**[10] | 4.9 | 7.2 | **240.2** | 246.5 | 160.2 |
| Interest expense | | | | **(21.2)** | (35.7) | (32.2) | | | |
| Earnings before taxes from continuing operations | | | | **$327.4** | $418.3 | $308.9 | | | |
| Net assets of discontinued operation | | | | | | | **—** | 14.5 | 160.2 |
| Total | | | | | | | **$2,470.7** | $2,258.1 | $2,224.3 |

**Description of Industry Segments** The aerospace business is organized into three major segments. Space and strategic systems programs, performed principally by operating companies at Denver and Michoud, consist mainly of launch vehicles, spacecraft, and associated electronics and instrumentation.

The defense electronics and tactical systems segment is devoted to the development and production, primarily at Orlando and Ocala, Florida, of missile systems, precision guided projectiles, air defense systems, and electro-optical target acquisition, designation, and navigation systems.

The principal aero-mechanical systems programs are at the Baltimore operation and include missile launching systems, jet engine fan reversers, airframe component manufacturing and assembly, and combat systems development, engineering, production, and integration.

The information systems segments serve government and commercial customers in a broad range of information management, data processing, and telecommunications programs. The data systems business provides systems installation and management, computing services, applications software, and consulting services to government and commercial customers and manages the Corporation's internal computer operations. The information and communications systems business provides sophisticated systems combining high-speed communications and information processing for such purposes as command, control, and communications systems, air traffic control,

| Property Additions | | | Depreciation, Depletion, Amortization | | |
|---|---|---|---|---|---|
| **1986** | 1985 | 1984 | **1986** | 1985 | 1984 |
| **$ 78.7** | $ 49.9 | $ 47.9 | **$ 25.2** | $ 19.0 | $ 15.5 |
| **67.2** | 163.4 | 65.1 | **47.0** | 37.7 | 27.1 |
| **15.2** | 8.5 | 14.0 | **9.5** | 8.2 | 6.4 |
| **161.1** | 221.8 | 127.0 | **81.7** | 64.9 | 49.0 |
| **29.7** | 33.0 | 26.5 | **24.7** | 22.3 | 17.5 |
| **5.2** | — | — | **1.7** | — | — |
| **34.9** | 33.0 | 26.5 | **26.4** | 22.3 | 17.5 |
| **45.1** | 19.3 | 16.7 | **22.5** | 20.3 | 19.9 |
| **3.4** | 1.7 | 7.9 | **6.6** | 7.3 | 7.2 |
| **.7** | 6.3 | 17.2 | **7.7** | 9.5 | 14.4 |
| **49.2** | 27.3 | 41.8 | **36.8** | 37.1 | 41.5 |
| **245.2** | 282.1 | 195.3 | **144.9** | 124.3 | 108.0 |
| **28.2** | 34.0 | 10.2 | **8.1** | 7.7 | 5.6 |
| **$273.4** | $316.1 | $205.5 | **$153.0** | $132.0 | $113.6 |

telecommunications, and integrated communications networks.

The materials business consists of aggregates operations principally engaged in quarrying, processing, and selling crushed stone and gravel—primarily for highway and general construction and railroad ballast—and magnesia specialties operations, which quarry, process, and sell refractory materials and other magnesia products used in steel production, chemical processing, and various industrial applications.

[1]Sales made directly or under subcontract to the U.S. Government amounted to approximately $3.55 billion in 1986, $3.39 billion in 1985, and $2.91 billion in 1984 for Aerospace Systems; and $503 million in 1986, $399 million in 1985, and $233 million in 1984 for Information Systems (excluding sales on government contracts reported through aerospace operations).

[2]Operating profit in 1985 and 1984 has been restated to reclassify certain costs to corporate previously included in the results of operating segments. These costs are reflected as corporate costs to conform to the organizational structure in place during 1986.

[3]Includes $1.9-million fourth-quarter loss from the sale of its packaged software business, net of gain from the sale of a minority interest of 25% in Hoskyns Group Limited (see Note M).

[4]Net sales and operating profit for the Information & Communications Systems company in 1985 and 1984 were included in the aerospace segment and have been restated to reflect the results of this segment separately. Its assets employed, property additions, and depreciation for 1985 and 1984 are included in the aerospace segment because disaggregation was impractical.

[5]In the fourth quarter of 1985, $7.2 million was charged to earnings in connection with the write-off of a permanently closed refractories plant.

[6]Materials, Other represents net sales and other financial data for sold operations and includes, under operating profit, gain from dispositions, and, under assets employed, the net cost of properties underlying certain operating leases (see footnote 7, below).

[7]Includes gain from sales of operations of $103 million in 1985 from sale of the Master Builders division in the second quarter and $18.6 million in 1984 from disposition of two cement plants.

[8]Corporate sales include: fee received for managing the Department of Energy's complex at Oak Ridge, Tennessee, and Paducah, Kentucky; fee received for managing a U.S. Army ordnance plant; revenues generated by the Corporation's research laboratories; and other. General corporate expenses are net of management fees and net sundry income relating to corporate assets. Corporate assets consist principally of general corporate properties, properties of a real estate subsidiary in Maryland, and in 1984, $388 million of notes and other amounts due from the sale of the aluminum company and a related transaction.

[9]Intersegment sales consisted principally of Data Systems services to aerospace operations.

[10]Operating profit from investments includes equity in the earnings (losses) of nonconsolidated subsidiaries and associated companies and gain from sales of investments: $17.6 million in 1986 principally from the sale of an interest in a biotechnology company, including $7.5 million in the first quarter, and $10.1 million in the third quarter (see Note M).

**Orlando's Roseanne Freeman precisely measures the curvature of a plastic dome for a laser guidance system.**

# Analysis of Financial Condition and Operating Results

Martin Marietta continued in excellent financial condition in 1986. The Corporation had the liquidity, principally from internally generated cash flows, and the capital resources necessary to operate its businesses, finance internal growth, pursue new business opportunities, pay dividends, and repurchase shares to enhance the value of shareowners' holdings. Backlog remained high, the Corporation's earnings from operations increased 13%, and equity increased 19%.

**Liquidity and Capital** Net working capital was $176 million at December 31, 1986. The Corporation's ratio of long-term debt to total capitalization was 21% at December 31, 1986, compared with 24% a year earlier. Martin Marietta's return on equity was 26% for 1986.

Net cash flow from continuing operating activities was $360 million in 1986, $270 million in 1985, and $318 million in 1984, primarily from earnings and depreciation, net of increases in receivables and inventories. Receivables and inventories increased in 1985 and 1986 due to the expansion in government contract business. Net earnings included nonrecurring gains, principally from sales of operations, and in 1986, from sale of an investment. These gains increased net earnings by $16 million in 1986, $73 million in 1985, and $11 million in 1984. Capital expenditures were $273 million in 1986, $316 million in 1985, and $205 million in 1984. In January, 1987, the Board of Directors approved new capital authorizations of $335 million.

Enactment of the Tax Reform Act of 1986 reduces the U.S. corporate tax rate from 46% to 40% in 1987 and to 34% in 1988. The benefits from such rate reductions will be affected by other changes, including repeal of the investment tax credit, reinstatement of the research tax credit, a revised system of tax depreciation, a new alternative minimum tax, and creation of a new method of tax accounting (percentage of completion-capitalization cost method) for long-term contracts entered into after February, 1986.

The impact of the Act on net earnings over the next three years is expected to be favorable, principally as a result of the lower tax rates.

Over the next three years, however, the Corporation estimates U.S. income tax payments of $370 million, which are $120 million greater due to the effects of the new law, principally as a result of the timing of reporting profits on long-term contracts and the repeal of the investment tax credit.

The Board of Directors authorized two separate purchases of the Corporation's common stock in 1986—repurchase of up to 1,500,000 shares for treasury and purchase by Martin Marietta's Retirement Trust of up to 1,500,000 shares. At 1986 year-end, 477,550 shares had been purchased by the Retirement Trust and 477,550 shares had been repurchased for treasury, including 350,700 shares purchased under the 1986 authorization. In 1986, an additional 53,700 shares were repurchased under a 1985 authorization to purchase up to 3,300,000 shares for anticipated exercise under the Corporation's stock option plans.

**Capital Resources** Martin Marietta's broad access to capital markets and excellent internal cash flows are sufficient to provide the capital resources necessary to support increased operating needs and to finance continued growth. Martin Marietta's principal in-place borrowing facility is a Revolving Credit and Term Loan Agreement with a group of banks for $500 million which may be used for general corporate purposes, including working capital and back-up for commercial paper.

Martin Marietta's commercial paper is rated A-1 by Standard & Poor's, Prime-1 by Moody's, and 1 by Duff and Phelps. The Corporation's senior debt is rated A by Standard & Poor's, A2 by Moody's, and 5 by Duff and Phelps.

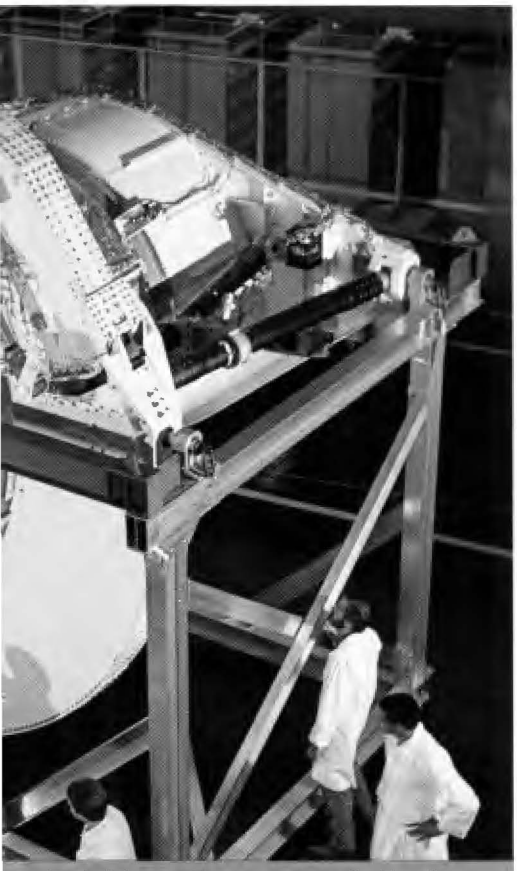
**Backlog** The Corporation's backlog was $8.6 billion at December 31, 1986, compared with $8.8 billion at December 31, 1985. Backlog at December 31, 1985, included a $1.2-billion order from the NASA for 60 additional external fuel tanks for the Space Shuttle program which, due to the Challenger accident, was not included as part of firm backlog at December 31, 1986. The NASA has directed the Corporation to prepare for production of the 60 tanks in anticipation of resumption of Shuttle missions. Backlog does not include the value of unexercised production options.

**Results of Operations** Net sales increased in each of the past two years to a record $4.8 billion for 1986. Net sales increased

$342 million, or 8%, in 1986 and $490 million, or 12%, in 1985.

The aerospace business, with 1986 sales of $3.7 billion, had sales gains of $230 million, or 7%, in 1986 and $386 million, or 12%, in 1985. The smaller percentage increase in sales for 1986 was due in part to the slowed production schedule for Space Shuttle External Tanks and the significant increase in 1985 in the number of defense electronics and tactical systems programs which reached increased production levels. Space and strategic systems sales in 1986 remained level with 1985, despite decreased External Tank production, due to expanded Titan launch vehicle business.

Information systems sales grew by 18% in 1986 and 40% in 1985, reflecting increases in communications and control contracts and other systems integration programs.



**Technicians at Denver prepare the Transfer Orbit Stage space vehicle for delivery. The stage is scheduled to ride the Space Shuttle into low-Earth orbit, where it will boost payloads into higher orbits.**

Sales from the materials business increased in 1986 after several years of declines attributable to sold operations. Aggregates sales increased by 20% in 1986 and by 6% in 1985. Magnesia Specialties sales declined by 6% in 1986 and by 15% in 1985, due to the current difficulties in this company's major market, the steel industry.

Earnings from operations increased 13% in 1986 and 3% in 1985. Operating profit increased in the defense electronics and tactical systems business by $34 million, or 26%, in 1986, and $42 million, or 46%, in 1985. Space and strategic systems operating profits declined by 12% in 1986, because of the decline in earnings from the External Tank program and the effect of significant fixed price programs in the development stages. Information & Communications Systems operating profits have been relatively low principally due to the effects of higher spending levels for new business opportunities. Data Systems operating losses, reduced in 1986, were principally attributable to persistent weakness in the market for software products. In the fourth quarter of 1986, its packaged software business was sold at a loss that was largely offset by a gain from the sale of a 25% interest in the Hoskyns Group subsidiary. Aggregates profits increased 18% in 1986, up from the 13% increase in 1985. Magnesia Specialties operated at a small profit in 1986 after a year-earlier loss principally attributable to a $7-million write-down of a plant that was permanently closed.

In 1986, the Corporation adopted a new accounting standard, which reduced pension cost by $16 million, or $.16 per share.

Other income and expenses decreased $142 million in 1986 to $18 million and increased by $105 million in 1985 from the prior year. Other income in 1985 included a $103-million nonrecurring pre-tax gain from the sale of the Master Builders division, which compared with $23 million of gain from asset dispositions in 1984. In 1986, nonrecurring gains amounted to $16 million, primarily from sale of the Corporation's minority investment in a biotechnology company. Equity in net losses of nonconsolidated subsidiaries and associated companies totaled $18 million in 1986 and included an estimated loss related to Equatorial Communications Company and a net loss from a metals fabrication joint venture. Interest income in 1985 of $34 million was about $25 million higher than in both 1986 and 1984 and resulted from higher short-term investment balances during 1985 and from interest earned on notes received from sale of the aluminum business.

Interest expense on debt decreased $15 million, or 41%, in 1986 and increased $3 million, or 11%, in 1985. The decrease in 1986 expense was mainly from reduced debt service after redemption of a $25-million note in early 1986 and of $100 million of notes in late 1985. Interest expense in 1984 was net of $30 million allocated to discontinued operations.

The effective income tax rate for 1986 was 38%, compared with 40% in 1985 and 43% in 1984. The lower tax rates on the gain from sale of the Master Builders division was reflected in a lower effective rate in 1985 compared with 1984. The recent Woods Investment tax court decision reduced the effective rate in 1986 and is the main reason for the decline from 1985.

The impact of inflation on the Corporation's results has become less significant with reductions in the inflation rate in recent years. When the Corporation incurred higher costs to replace productive facilities, the increased depreciation generally was offset by increased productivity, increased selling prices, and other factors that ameliorated the effects of higher replacement costs.

# Quarterly Performance

(Unaudited)

(millions, except per share)

| Quarter | Net Sales | | Earnings From Operations | | Net Earnings | |
|---|---|---|---|---|---|---|
| | **1986** | 1985 | **1986** | 1985 | **1986** | 1985 |
| First | **$1,084.2** | $1,006.8 | **$ 55.6** | $ 49.3 | **$ 48.4** | $ 27.8 |
| Second | **1,226.5** | 1,108.3 | **98.3** | 89.2 | **57.3** | 122.0 |
| Third | **1,173.4** | 1,086.4 | **83.4** | 77.4 | **53.2** | 49.7 |
| Fourth | **1,268.4** | 1,208.6 | **93.4** | 77.8 | **43.4** | 49.9 |
| Year | **$4,752.5** | $4,410.1 | **$330.7** | $293.7 | **$202.3** | $249.4 |

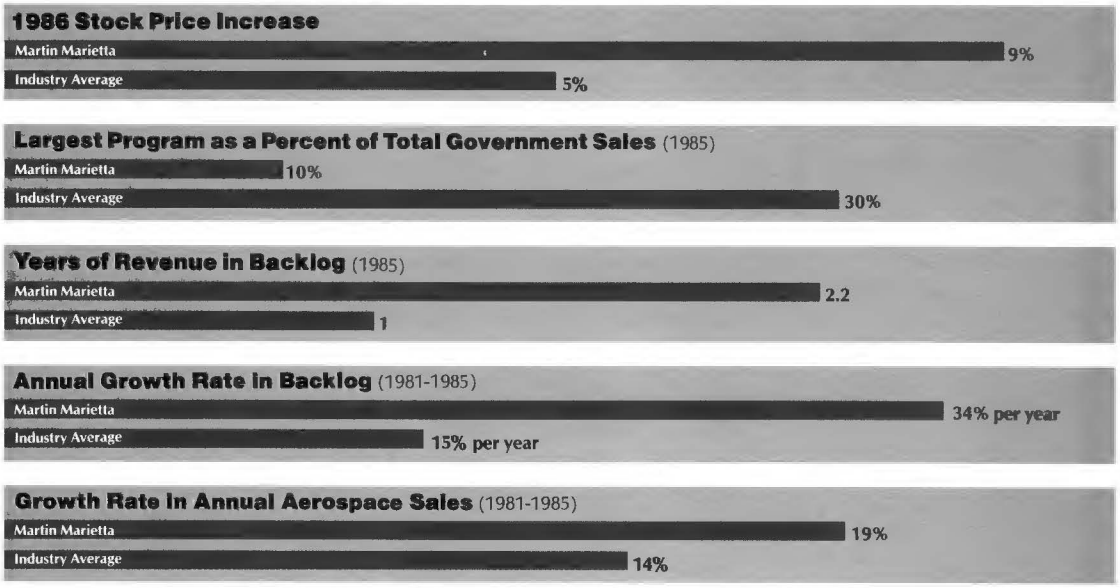
| Quarter | Net Earnings Per Share | | Common Stock Prices and Dividends Paid: Market price High | Market price Low | Dividends paid | Market price High | Market price Low | Dividends paid |
|---|---|---|---|---|---|---|---|---|
| | **1986** | 1985 | **1986** | | **1986** | 1985 | | 1985 |
| First | **$ .88** | $ .47 | **44⅜** | **32¼** | **$ .25** | 36¼ | 27⅜ | $.223 |
| Second | **1.04** | 2.09 | **48½** | **40½** | **.25** | 39⅜ | 32⅛ | .25 |
| Third | **.96** | .84 | **47⅞** | **38⅝** | **.25** | 44⅜ | 32 | .25 |
| Fourth | **.79** | .89 | **44⅝** | **37⅜** | **.25** | 38¼ | 31¼ | .25 |
| Year | **$3.67** | $4.36 | | | **$1.00** | | | $.973 |

In December, 1986, the Corporation adopted Statement of Financial Accounting Standards No. 87, which required a change in the method of calculating pension expense (see Note L). Results of each of the first three quarters were increased by 4 cents a share to show the retroactive effect of this change. As a result of the new tax law, fourth-quarter 1986 net earnings were reduced by 10 cents a share, principally to reverse investment tax credit recognized in the first three quarters.

Per share earnings by quarter for 1985 do not equal net earnings per share for the year because the average shares outstanding increased during the second quarter.

Additional quarterly performance information is contained in Note Q.

# Aerospace Industry Comparisons



# Five Year Summary

(add 000, except per share)

| | 1986 | 1985 | 1984 | 1983 | 1982 |
|---|---|---|---|---|---|
| **Operating Results** | | | | | |
| Net sales | **$4,752,537** | $4,410,064 | $3,920,400 | $3,228,061 | $3,033,082 |
| Cost of sales, other costs, and expenses | **4,421,794** | 4,116,358 | 3,634,082 | 2,998,445 | 2,872,363 |
| **Earnings from Operations** | **330,743** | 293,706 | 286,318 | 229,616 | 160,719 |
| Other income and expenses | **17,882** | 160,290 | 54,833 | 135,343 | 51,152 |
| | **348,625** | 453,996 | 341,151 | 364,959 | 211,871 |
| Interest expense on debt | **21,181** | 35,704 | 32,237 | 63,939 | 32,284 |
| Earnings before taxes on income | **327,444** | 418,292 | 308,914 | 301,020 | 179,587 |
| Taxes on income | **125,100** | 168,900 | 132,900 | 139,400 | 73,900 |
| **Earnings from Continuing Operations** | **202,344** | 249,392 | 176,014 | 161,620 | 105,687 |
| **Discontinued Operation:** | | | | | |
| Operating losses, net of income taxes | **—** | — | (2,778) | (20,289) | (14,045) |
| Estimated losses from disposal, net of income taxes | **—** | — | (365,000) | — | — |
| **Losses from Discontinued Operation** | **—** | — | (367,778) | (20,289) | (14,045) |
| **Net Earnings (Losses)** | **202,344** | 249,392 | (191,764) | 141,331 | 91,642 |
| Dividends on preferred stock | **—** | 2,803 | 11,213 | 10,995 | — |
| Net earnings (losses) applicable to common stock | **$ 202,344** | $ 246,589 | $ (202,977) | $ 130,336 | $ 91,642 |
| **Per Common Share** | | | | | |
| Net earnings (losses) | | | | | |
| Assuming no dilution: | | | | | |
| Continuing Operations | **$3.67** | $4.36 | $ 3.15 | $3.26 | $1.50 |
| Discontinued Operation | **—** | — | (7.03) | (.44) | (.20) |
| | **$3.67** | $4.36 | $(3.88) | $2.82 | $1.30 |
| Assuming full dilution: | | | | | |
| Continuing Operations | **$3.67** | $4.36 | $ 3.02 | $3.09 | $1.50 |
| Discontinued Operation | **—** | — | * | (.39) | (.20) |
| | **$3.67** | $4.36 | * | $2.70 | $1.30 |
| Cash dividends | **$1.00** | $.973 | $ .893 | $.863 | $.853 |
| **Condensed Balance Sheet Data** | | | | | |
| Current assets, excluding discontinued operation | **$1,005,376** | $ 954,470 | $ 781,448 | $ 508,506 | $ 515,986 |
| Net assets of discontinued operation: | | | | | |
| Current | **—** | 14,499 | 70,440 | 244,214 | 215,235 |
| Noncurrent | **—** | — | 89,798 | 525,884 | 526,221 |
| Net property, plant, and equipment | **1,059,071** | 949,336 | 807,770 | 750,882 | 934,644 |
| Investments, other assets, and intangibles | **406,298** | 339,764 | 474,864 | 350,595 | 284,057 |
| Total | **$2,470,745** | $2,258,069 | $2,224,320 | $2,380,081 | $2,476,143 |
| Current liabilities | **$ 829,641** | $ 771,027 | $ 804,185 | $ 665,696 | $ 554,244 |
| Long-term debt | **227,700** | 220,413 | 347,081 | 549,586 | 1,152,921 |
| Other noncurrent liabilities | **116,998** | 93,175 | 80,045 | 52,660 | 20,879 |
| Noncurrent deferred income taxes | **453,030** | 465,497 | 366,896 | 266,783 | 311,539 |
| Shareowners' equity | **843,376** | 707,957 | 626,113 | 845,356 | 436,560 |
| Total | **$2,470,745** | $2,258,069 | $2,224,320 | $2,380,081 | $2,476,143 |

*Anti-dilutive

# Martin Marietta Corporation

## Board of Directors

**Thomas G. Pownall**
Chairman and Chief Executive Officer, Martin Marietta Corporation

**Laurence J. Adams**
Retired President and Chief Operating Officer, Martin Marietta Corporation

**Norman R. Augustine**
President and Chief Operating Officer, Martin Marietta Corporation

**Griffin B. Bell**
Senior Partner, King & Spalding
(attorneys)

**John J. Byrne**
Chairman and Chief Executive Officer, Fireman's Fund Corporation
(property and casualty insurance)

**A. James Clark**
President and Chief Executive Officer, Clark Enterprises, Inc.
(multi-unit construction company)

**James L. Everett, III**
Chairman and Chief Executive Officer, Philadelphia Electric Company
(public utility)

**Edward L. Hennessy, Jr.**
Chairman and Chief Executive Officer, Allied-Signal Inc.
(diversified manufacturer)

**Melvin R. Laird**
Senior Counsellor, The Reader's Digest Association, Inc.
(publishing)

**John K. McKinley**
Retired Chairman and Chief Executive Officer, Texaco Inc.
(integrated producer of petroleum and petrochemicals)

**J. Donald Rauth**
Retired Chairman, Martin Marietta Corporation

**John B. Slaughter**
Chancellor, The University of Maryland

**John W. Vessey, Jr.**
Retired Chairman of the Joint Chiefs of Staff

## Officers

**Thomas G. Pownall**
Chairman and Chief Executive Officer

**Norman R. Augustine**
President and Chief Operating Officer

**David C. Dressler**
Senior Vice President

**Caleb B. Hurtt**
Senior Vice President

**Dan A. Peterson**
Senior Vice President

**Marcus C. Bennett**
Vice President

**J. Peter Dunston**
Vice President

**Bobby F. Leonard**
Vice President

**Melvin A. McCubbin**
Vice President and Chief Financial Officer

**Frank H. Menaker, Jr.**
Vice President and General Counsel

**Robert J. Polutchko**
Vice President

**Robert W. Powell, Jr.**
Vice President and Treasurer

**Philip H. Sendel**
Vice President

**Peter B. Teets**
Vice President

**A. Thomas Young**
Vice President

**Janice K. Henry**
Secretary

**Audit and Ethics Committee:** Mr. Bell, Chairman. Messrs. Adams, Everett, Hennessy, Laird, Rauth, and Vessey.
**Compensation Committee:** Mr. Everett, Chairman. Messrs. Adams, Hennessy, McKinley, Rauth, and Vessey.
**Executive Committee:** Mr. Rauth, Chairman. Messrs. Adams, Augustine, Bell, Byrne, Clark, Laird, and Pownall.
**Finance Committee:** Mr. Clark, Chairman. Messrs. Augustine, Bell, Byrne, Hennessy, Laird, and Pownall.
**Nominating Committee:** Mr. Rauth, Chairman. Messrs. Byrne, Clark, Everett, and McKinley.

**Transfer Agents & Registrars**
Morgan Shareholder Services
Trust Company
30 West Broadway
New York, New York 10007

Maryland National Bank
225 North Calvert Street
Baltimore, Maryland 21203

**Listings**
New York Stock Exchange
Pacific Stock Exchange
Philadelphia Stock Exchange
Midwest Stock Exchange
London Stock Exchange

Ticker symbol: **ML**
Newspapers: **MartM**

**Auditors**
Ernst & Whinney

**Executive Offices**
6801 Rockledge Drive
Bethesda, Maryland 20817
Telephone: (301) 897-6000

## Principal Facilities and Operations

### Space and Strategic Systems

**Martin Marietta Denver Aerospace**
Denver, Colorado
Vandenberg AFB, California
Cape Canaveral AFS, Florida

**Martin Marietta Michoud Aerospace**
New Orleans, Louisiana

### Defense Electronics and Tactical Systems

**Martin Marietta Orlando Aerospace**
Orlando and Ocala, Florida

### Aero-Mechanical Systems

**Martin Marietta Baltimore Aerospace**
Baltimore, Maryland

### Information Systems

**Martin Marietta Data Systems**
Bethesda and Greenbelt, Maryland
Denver, Colorado
Orlando, Florida
London, England

**Martin Marietta Information & Communications Systems**
Bethesda, Maryland
Denver, Colorado
Orlando, Florida
Washington, D.C.

### Materials

**Martin Marietta Aggregates**
Raleigh, North Carolina

**Martin Marietta Magnesia Specialties**
Hunt Valley, Maryland

### Other Operations

**Martin Marietta Energy Systems, Inc.**
Oak Ridge, Tennessee
Paducah, Kentucky
Piketon, Ohio

**Martin Marietta Environmental Systems**
Columbia, Maryland

**Martin Marietta Laboratories**
Baltimore, Maryland

**Martin Marietta Ordnance Systems, Inc.**
Bethesda, Maryland
Milan, Tennessee

**Chesapeake Park, Inc.**
Baltimore, Maryland
Oak Ridge, Tennessee

**Orlando Central Park, Inc.**
Orlando, Florida

MARTIN MARIETTA